SMITHSONIAN INSTITUTION
WASHINGTON, D.C.

SHOUT
SHARE
IT

SMITHSONIAN
INSTITUTION

MUSEUM
OF
NATURAL
HISTORY

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402 - Price $1 (paper cover)

UNITED STATES NATIONAL MUSEUM BULLETIN 251

Pacific Tunicata of the United States National Museum

TAKASI TOKIOKA

Seto Marine Biological Laboratory, Japan

SMITHSONIAN PRESS
WASHINGTON, D.C.
1967

Publications of the United States National Museum

The scientific publications of the United States National Museum include two series, *Proceedings of the United States National Museum* and *United States National Museum Bulletin.*

In these series are published original articles and monographs dealing with the collections and work of the Museum and setting forth newly acquired facts in the field of anthropology, biology, geology, history, and technology. Copies of each publication are distributed to libraries and scientific organizations and to specialists and others interested in the various subjects.

The *Proceedings,* begun in 1878, are intended for the publication, in separate form, of shorter papers. These are gathered in volumes, octavo in size, with the publication date of each paper recorded in the table of contents of the volume.

In the *Bulletin* series, the first of which was issued in 1875, appear longer, separate publications consisting of monographs (occasionally in several parts) and volumes in which are collected works on related subjects. *Bulletins* are either octavo or quarto in size, depending on the needs of the presentation. Since 1902, papers relating to the botanical collections of the Museum have been published in the *Bulletin* series under the heading *Contributions from the United States National Herbarium.*

This work forms number 251 of the *Bulletin* series.

Frank A. Taylor
Director, United States National Museum

U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON : 1967

Contents

Page
Introduction 1
Ascidiacea 22
  Order Aplousobranchia 22
    Family Synoicidae 22
    Family Didemnidae 62
    Family Polycitoridae 101
  Order Phlebobranchia 133
    Family Diazonidae 133
    Family Cionidae 133
    Family Perophoridae 136
    Family Ascidiidae 138
    Family Rhodosomatidae 148
  Order Stolidobranchia 151
    Family Botryllidae 151
    Family Styelidae 162
    Family Pyuridae 197
    Family Molgulidae 222
Appendicularia 228
    Family Oikopleuridae 228
Thaliacea 228
    Family Doliolidae 228
    Family Salpidae 229
Pyrosomata 230
    Family Pyrosomidae 230
Literature cited 232
Index 239

Pacific Tunicata

# of the

United States National Museum

Introduction

The previously unidentified Tunicata in the U.S. National Museum listed and described herein were collected from various parts of the Pacific, with the exception of the west coasts of North, Central, and South America. Most of the specimens belong to Ascidiacea, but a small number are pelagic tunicates, including Appendicularia, Thaliacea, and Pyrosomata.

As studies of the ascidian fauna in various parts of the Pacific are in progress I think it better, at present, to refrain from writing on general aspects of the ascidian fauna of the Pacific, leaving them for a future paper.

Many simple ascidians are identified rather easily, while the identification of compound ascidians is usually very exacting. Even repeatedly described species might be confused with others, as the range of intraspecific variation is not yet clearly defined for most species. Under these circumstances, it is rather useless to list only the species found in the material. Inevitably accurate descriptions accompanied with exact figures for those species must be made. Thus in this paper, most of the compound ascidians are described in detail, while most solitary forms are noted briefly.

In descriptions of the branchial sac, the number of stigmata in respective rows and of branchial plications is always given for only one side of the sac. The number of inner longitudinal vessels on respective branchial plications indicates the total number of vessels on both surfaces of each plication.

The specimens treated in this paper were examined during my stay at the United States National Museum, from February to April 1957, work which was supported with the financial aid of the National Academy of Sciences. I am very grateful to the staff of the United States National Museum, particularly the members of the Division of Marine Invertebrates, Dr. Fenner A. Chace and others, for granting me the space in the museum for research and assisting me in obtaining financial aid. Dr. Frederick M. Bayer, at that time of the

Division of Marine Invertebrates, who personally collected a large number of ascidians at Palau during the High Island-Atoll Project, Palau Islands, 1955, by the George Vanderbilt Foundation, and who kindly made all arrangements for me to carry out the present work. Indeed, without his generous help in providing every kind of facility for me, it would have been quite impossible to study so many specimens from various parts of the Pacific. I wish to express my hearty thanks to him for his kindness.

Included in the material are a number of important collections from the following sources:

1. United States Fish Commission Steamer *Albatross* during her North West Pacific Expedition 1899–1900, the Philippine Expedition 1907–09, and others;
2. The Palau Islands, 1955, by the George Vanderbilt Foundation;
3. Various parts of Japan, and presented to the United States National Museum by E. S. Morse, Professor at the Tokyo Imperial University, in exchange;
4. From Philippine waters in January 1941, by W. R. Taylor, U.S. National Museum;
5. In 1951 at the Gilbert Islands, by P. E. Cloud;
6. Dr. S. F. Light, Professor at the University of Amoy, presumably at Amoy, China;
7. Ascidians of the university of Hawaii.

In addition to these, a few specimens from other localities other than the Pacific were examined and described for comparison with the Pacific species.

Following is a list of George Vanderbilt Foundation (hereafter abbreviated GVF) stations at which tunicates were collected in the Palau Islands in 1955 by R. R. Harry and H. A. Fehlmann of Stanford University and F. M. Bayer of the U.S. National Museum. Geographical coordinates of each locality based upon U.S. Navy Hydrographic Office (HO) charts. Numbers of traverses and islands in Iwayama Bay follow the work of Abe (1937) and of Abe, Eguchi, and Hiro (1937).

Sta. 12. 9 July. Madalai District, extreme west end of Koror Island, shore at south end of Arakabesan-Madalai causeway, mangrove shore grading into mud and sand flat: 7°20′36″ N., 134°28′13″ E. (HO 6077, 1st ed., 1944). Depth 0–3 ft.; bottom of mud inshore grading into sand offshore; vegetation *Enhalus acoroides.*

Didemnum (Didemnum) ternatanum (Gottschaldt); *Eudistoma laysani* (Sluiter); *E. pyriforme* (Herdman).

Sta. 16. 11 July. Madalai District, west end of Koror Island outside of retaining wall enclosing sandy eelgrass flat. (Outer end of Abe's Traverse III): 7°20′22″ N., 134°28′05″ E. (HO 6077, 1st ed., 1944). Depth 3 ft.; bottom sand coral, rock; "olive green compound tunicate on *Enhalus* leaves."

Didemnum (Didemnum) ternatanum (Gottschaldt).

Sta. 25. 19 July. Barrier reef 8 miles northwest of Koror Island: 7°24′30″ N., 134°21′20″ E. (HO 6102, 1st ed., 1944). Depth 3–7 ft.; bottom sand and coral heads and dead coral.

Ascidia minuta Tokioka; *Botrylloides tyreum* Herdman; *Didemnum* (*Didemnum*) *candidum* Savigny; *D.* (*D.*) *moseleyi* (Herdman); *D.* (*D.*) *moseleyi* (Herdman) forma *granulatum* Tokioka; *D.* (*D.*) *nekozita*, n. sp.; *D.* (*Polysyncraton*) *sagamiana* Tokioka; *Eudistoma viridis* Tokioka; *Leptoclinides reticulatus* (Sluiter); *Lissoclinum pulvinum* (Tokioka); *Polycarpa* sp.; *Trididemnum savignii* (Herdman).

Sta. 23. 21 July. Outer reef at eastern end of Urukthapel Island, about 1½ miles north of Pkulasuch Point: 7°16′13″ N., 134°27′35″ E. (HO 6103, 1st ed., 1944). Depth 2–4 ft., in breakers; bottom covered with *Turbinaria.*

Botrylloides violaceus marginatus, n. subsp.; *Botryllus tuberatus* Ritter and Forsyth; *Polyclinum constellatum* Savigny.

Sta. 30. 22 July. Iwayama Bay, between south shore of Kaibakku (Island XXIX) and Kogai Hanto, Auluptagel Island (traverse XI): 7°19′12″ N., 134°29′37″ E. (HO 6076, 2d ed., 1944). Depth 0–3 ft.; sand, coral, with vegetation consisting mainly of *Enhalus* and *Caulerpa.*

Aplidium lobatum Savigny; *Didemnum* (*Didemnum*) *moseleyi* (Herdman).

Sta. 35. 24 July. Peliliu boat channel between Ngargersal and Kongauru Islands approximately 1 mile east of north tip of Peliliu Island: 7°02′51″ N., 134°17′42″ E. Depth 1–10 ft.; sand, silt, occasional coral; *Enhalus acoroides* and 2 other ssp. eelgrass; algae including *Caulerpa.*

Didemnum (*Didemnum*) *nekozita*, n. sp.

Sta. 53. 31 July. Ngaremdiu area, eastern Urukthapel; rocky cape west of sand beach Oiratel-ruul: 7°15′15″ N., 134°26′51″ E. (HO 6103, 1st ed., 1944). Depth 0–7 ft.; sand, coral, rock. Green in life growing on hydroid.

Eudistoma viridis Tokioka.

Sta. 60. 5 August. North shore of Koror Island, west of Ebadul's Pier: 7°20′48″ N., 134°28′12″ E. (HO 6076, 2d ed., 1944). Depth 0–5 ft.; sand flat; occasional coral heads, with *Enhalus* growing on sandy areas, *Sargassum* attached to rocks. Found with sponges.

Eudistoma sp. aff. *angolanum* (Michaelsen).

Sta. 61. 6 August. Seaward reef flat at south end of Ngemelis Island, west side of Palau Archipelago: 7°06′45″ N., 134°14′40″ E. (HO 6073, 2d ed., 1944). Depth 1½–6 ft.; coral and sand; some *Enhalus* and *Halimeda* in sand patches, on gorgonian.

Botrylloides violaceus Oka; *Didemnum* (*Didemnum*) *moseleyi* (Herdman); *Symplegma viride* Herdman.

Sta. 67. 7 August. Reef in pass west of Nghus ("Ankosu") southern tip of Urukthapel: 7°13′14″ N., 134°22′16″ E. (HO 6078, 1st ed.). Depth 5–7 ft.; bottom living and dead coral, sand, coral rubble.

Didemnum (*Didemnum*) *ternatanum* (Gottschaldt).

Sta. 85. 12 August. Iwayama Bay, shallow area in Geruherugairu Pass between Kaibakku Island and Kogai Hanto, Auluptagel Island: 7°19′12″ N., 134°29′37″ E. (HO 6076, 1st ed.). Depth 5–6 ft.; eelgrass, coral and sand flat, artificial rock barrier, found with *Halimeda.*

Ascidia minuta Tokioka; *Leptoclinides reticulatus* (Sluiter); *Trididemnum savignii jolense* (Van Name).

Sta. 85A. Same data as 85. Tide rising, depth 2–3½ ft.

Leptoclinum virens Hartmeyer.

Sta. 92. 14 August. Iwayama Bay, south end of Guazima (Island XV): 7°20′00″ N., 134°29′37″ E. (HO 6076, 2d ed.). Depth 0–20 ft.; sandy flat and fringing reef, with vegetation of *Enhalus, Halimeda, Padina,* found with sponges.

Microcosmus curvus Tokioka; *Pyura curvigona* Tokioka.

Sta. 92A. Same data as 92. Tide rising, current about ½ knot. Water very murky. Found on limestone shelf.

Eudistoma amplum (Sluiter); *Phallusia julinea* Sluiter.

Sta. 100. 16 August. Iwayama Bay, Bay of the Dragon Palace, west side of Kogai Hanto peninsula, Auluptagel Island between Usa and Tai Islands: 7°18′45″ N., 134°29′30″ E. (HO 6076, 2d ed.). Depth 5–15 ft.; bottom coral with sand in pockets.

Lissoclinum fragile (Van Name); *Polycarpa iwayamae* Tokioka.

Sta. 111. 19 August. Reef flat, Ngaremediu, east side of Urukthapel Island. (HO 6078, 1st ed.). Depth 0–1 ft.; exposed boulder flat.

Lissoclinum patella (Gottschaldt).

Sta. 125. 24 August. 1¾ miles NE. of Ngabadangel "Cape Gabadaguru": 7°17′36″ N., 134°21′42″ E. (HO 6103, 1st ed.). Depth 17 fathoms; *Halimeda* sand and *Scriatopora.* ("Gloria Maris" sta. 452, haul 1.)

Distaplia mikropnoa (Sluiter); *Trididemnum savignii jolense* (Van Name).

Sta. 134. 28 August. Iwayama Bay, south end of Island XX: 7°19′40″ N., 134°29′35″ E. (HO 6076, 2d ed.). Depth 3–20 ft.; reef shelf and slope, bottom entirely coral, found on sponge.

Amaroucium constrictum Sluiter; *Didemnum* (*Didemnum*) *candidum* Savigny; *D.* (*D.*) *moseleyi* (Herdman); *Phallusia julinea* Sluiter; *Pyura curvigona* Tokioka; *P. vittata* (Stimpson).

Sta. 135. 28 August. Iwayama Bay, west side of Island XXII, 7°19′38″ N., 134°29′55″ E. (HO 6076, 2d ed.). Depth 0–15 ft.; reef shelf and slope, solid coral and limestone.

Polycarpa captiosa (Sluiter).

Sta. 136. 28 August. Reef flat outside of large cave, SE. end of Koror at east entrance to Iwayama Bay, 7°18′34″ N., 134°30′24″ E. (HO 6076, 2d ed.). Depth 4–6 ft.; bottom sand, branched coral with *Enhalus, Halimeda, Padina.*

Trididemnum savignii jolense (Van Name).

Sta. 218. 10 October. Iwayama Bay, west shore of Island XXII opposite west peninsula of Island XX: 7°19′35″ N., 134°29′53″ E. (HO 6076, 2d ed.). Depth 3–10 ft.; coral, dead and living, "slender simple ascidian growing on *Isognomon.*"

Euherdmania digitata Millar.

Sta. 220. 12 October. Iwayama Bay, east side of Oyster Pass (Kakisuido) between Island XXIX and east end of Koror: 7°18′57″ N., 134°30′09″ E. (HO 6076, 2d ed.). Depth 3–20 ft., bottom limestone, with living and dead coral.

Amaroucium crateriferum Sluiter; *Clavelina moluccensis* (Sluiter); *Clavelina* (*Synclavella*) *arafurensis* Tokioka; *Didemnum* (*Didemnum*) *moseleyi* (Herdman); *D.* (*D.*) *moseleyi* forma *granulatum* Tokioka; *Ecteinascidia imperfecta* Tokioka; *Eudistoma amplum* (Sluiter); *Lissoclinum fragile* (Van Name); *Perophora formosana* (Oka); *Polycarpa cryptocarpa* (Sluiter); *P. iwayamae* Tokioka; ? *P. quadrata* Herdman.

Sta.220A. 22 October. Same data as 220; from submarine cave along shore southward. Depth 2–15 ft.

Didemnum (*Didemnum*) *candidum* Savigny; *Hypodistoma vastum* (Millar); *Polycarpa iwayamae Tokioka.*

Sta. 227. 15 October. East reef about 1¾ miles south of Ngaremdiu, end of reef called Uchulachei: 7°13′05″ N., 134°26′30″ E. (HO 6078, 1st ed.). Depth 0–20 ft.; coral, patches of sand.

Amaroucium multiplicatum (Sluiter); *Botrylloides violaceus marginatus*, n. subsp.; *Clavelina fecunda* (Sluiter).

Sta. 236. 18 October. Iwayama Bay, mouth of Kakisuido (Oyster Pass) between Island XXIX and east end of Koror. Coral shelf, west shore (bay shore) of southeast peninsula of Koror: 7°19′00″ N., 134°30′11″ E. (HO 6076, 2d ed.). Depth 3–20 ft.; Coral, living and dead; limestone.

Polycarpa cryptocarpa (Sluiter).

Sta. 236A. 20 October. Same data.

Amaroucium crateriferum Sluiter; *Botryllus primigenus* Oka; *Clavelina moluccensis* (Sluiter); *Clavelina* (*Synclavella*) *arafurensis* Tokioka; *Didemnum* (*Didemnum*) *nekozita*, n. sp.; *D.* (*D.*) *ternatanum* (Gottschaldt).

Sta. 252. 27 October. Fringing reef of small island in west part of Eil Malk lagoon (Meharehar): 7°10′01″ N., 134°21′50″ E. (HO 6078, 1st ed.) Depth 0–10 ft.; limestone shelf, limestone, coral, sand.

Amaroucium multiplicatum (Sluiter); *Didemnum* (*Didemnum*) *candidum* Savigny; *D.* (*D.*) *sphaericum*, n. sp.; *Eudistoma viridis* Tokioka; *Leptoclinum virens* Hartmeyer; *Lissoclinum molle* (Herdman); *Polycarpa cryptocarpa* (Sluiter); *Trididemnum savignii* (Herdman).

Sta. 261. 3 November. Sand flat between two islands of Ngerkuid (70 Islands) approximately 4¼ miles west of Eil Malk; 7°10′16″ N., 134°16′30″ E. (HO 6102, 1st ed.). Depth 2–4 ft.; bottom sand, found with mollusks.

Amaroucium aff. *monotonicum* Tokioka; *A. multiplicatum* (Sluiter); *Didemnum* (*Didemnum*) *moseleyi* (Herdman); *D.* (*D.*) *ternatanum* (Gottschaldt); *Lissoclinum pulvinum* (Tokioka); *Polyclinum tsutsuii* Tokioka.

The following stations were made in connection with a field survey of Saipan, Marianas Islands, by Preston E. Cloud in 1949. USNM Acc. 183733:

Sta. Loc. 2. 28 April. Lagoon west of Saipan, entrance to Tanapag Lagoon, from ½ ton block; attached to the surface of a large dead coral; brought up on anchor of L.T. 535, Captain Ted Harris, preserved May 2.

Eudistoma angolanum (Michaelsen); *Microcosmus exasperatus* Heller; *Polycarpa melanosiphonica*, n. sp.

Sta. Loc. 4. 20 June. Lagoon west of Saipan, 500 yards NNE. of Managaha Island. Leeward lagoon, from coral; depth 4–10 ft.

Microcosmus curvus Tokioka; *M. exasperatus* Heller.

Sta. D–7. 13 May. Lagoon west of Saipan, lagoon of Tanapag Harbor. Depth 9–22 ft. Dead patch reefs encrusted with living crustose coralline algae (the dominant reef building agent) on medium- to coarse-grained limesand bottom.

Ascidia gemmata Sluiter; *Cnemidocarpa areolata* (Heller); *C. incubita* (Sluiter); *Eudistoma angolanum* (Michaelsen); *Polyclinum vasculosum* Pizon.

Sta. D–8. 13 May. Lagoon west of Saipan, lagoon of Tanapag Harbor. Depth 36–42 ft.; patch of dead coral-algae rock on very coarse-grained limesand bottom.

Aplidium lobatum Savigny; *Eudistoma angolanum* (Michaelsen); *Eudistoma marianense*, n. sp.; *Herdmania momus* (Savigny); *Microcosmus exasperatus* Heller; *Polycarpa captiosa* (Sluiter); *Trididemnum savignii* (Herdman).

Sta. E–7. Lagoon west of Saipan, lagoon near Schildkrate Rock. Depth 10–60 ft.; bottom of dead coral-algae rocks on medium- to coarse-grained limesand.
Aplidium sp. aff. *lobatum* Savigny.

The following stations were made in the Philippine Islands by W. R. Taylor in January 1941, collected by Balhani, a Moro. USNM Acc. 159992:

Sta. 5. Large Sibago Island, coral reef; ½ fathom.
Lissoclinum pulvinum (Tokioka); *Trididemnum viride* (Herdman).

Sta. 7. Small Sibago Island, coral reef, rocky; encrusting *Halimeda*; 1 fathom.
Didemnum (*Didemnum*) *dorotubu* Tokioka; *Lissoclinum fragile* (Van Name).

Sta. 10. Baliwasan, near the Sea Food Cannery.
Didemnum (*Didemnum*) *candidum* (Savigny); *D.* (*D.*) *dorotubu* Tokioka; *D.* (*D.*) *moseleyi* (Herdman); *D.* (*D.*) *nekozita*, n. sp.; *D.* (*D.*) *ternatanum* (Gottschaldt); *Echinoclinum philippinense*, n. sp.; ?*Eudistoma tokarae* Tokioka; *Lissoclinum fragile* (Van Name); *L. pulvinum* (Tokioka); *Polyclinum vasculosum* Pizon; *Trididemnum viride* (Herdman).

Sta. 10—jar. 2. Same data as sta. 10. Attached to a piece of alcyonarian.
Aplidium sp. aff. *depressum* Sluiter; *Didemnum* (*Didemnum*) *dorotubu* Tokioka; *Polyclinum tsutsuii* Tokioka; *Trididemnum viride* (Herdman).

Sta. 11—jar 2. Sangboy Island, rocky coral reef; 1½ fathoms.
Didemnum (*Didemnum*) *candidum* (Savigny); *Lissoclinum pulvinum* (Tokioka); *Trididemnum viride* (Herdman).

Sta. 31. Punta Natangol, Basilan Island; sandy rocky coral reef; ½ fathom.
Didemnum (*Didemnum*) *candidum* (Savigny); *D.* (*D.*) *ternatanum* (Gottschaldt); *Echinoclinum philippinense*, n. sp.; *Leptoclinum virens* Hartmeyer; *Lissoclinum patella* (Gottschaldt); *L. pulvinum* (Tokioka); *Trididemnum viride* (Herdman).

Sta. 38. Kilay Island near Langos Island; sandy, rocky and coral reef.
Didemnum (*Didemnum*) *candidum* (Savigny); *Lissoclinum pulvinum* (Tokioka); *Trididemnum viride* (Herdman).

Sta. 40. Balukbuluk Island; sandy, rocky coral reefs.
Didemnum (Didemnum) *candidum* (Savigny); *Leptoclinum virens* Hartmeyer; *Lissoclinum patella* (Gottschaldt); *L. pulvinum* (Tokioka); *Trididemnum savignii jolense* (Van Name); *T. viride* (Herdman).

Sta. 41. Boboh near Matanal Point; sandy rocky coral reef; ½ fathom.
Didemnum (*Didemnum*) *candidum* (Savigny); *Leptoclinum virens* Hartmeyer; *Lissoclinum pulvinum* (Tokioka); *Trididemnum viride* (Herdman).

——. Amoyloi Reefs at the southern part of Basilan Island; sandy, stony and coral reefs; ½ fathom.
Trididemnum viride (Herdman).

——. Bavara in Pangapuyan Island at the other side of Sitio; sandy, muddy, stony with eelgrasses; 1 fathom.
Didemnum (*Didemnum*) *moseleyi* (Herdman); *Leptoclinum; Perophora.*

——. Manicaan; sandy with short eelgrasses and little coral reefs; 3 fathoms.
Didemnum (*Didemnum*) *candidum* (Savigny); *Leptoclinum virens* Hartmeyer; *Lissoclinum pulvinum* (Tokioka); *Trididemnum viride* (Herdman).

——. Tundun Pasil near the lighthouse at the Isabela Channel, Basilan Island, rocky coral reef; 1 fathom.
Didemnum (*Didemnum*) *candidum* (Savigny); *D.* (*D.*) *ternatanum* (Gottschaldt); *Lissoclinum fragile* (Van Name); *L. patella* (Gottschaldt); *L. pulvinum* (Tokioka); *Trididemnum viride* (Herdman).

The following stations were made on Onotoa Atoll, Gilbert Islands, by Preston E. Cloud (GOC–No.) and A. H. Banner (B–No.) in 1951, USNM Acc. 195327 and Arno Atoll, Marshall Islands; P. E. Cloud:

Sta. GOC–23. 30 July. Slightly less than 4 miles N. 85° W. from Aioka Maneaba in outer lagoon. Patch reefs rising above the limesand surface to 14 feet to within 6 feet of the surface.

Eudistoma angolanum (Michaelsen).

Sta. GOC–35. 10 August. About 8,600 feet N. 18° W. from Tabuarorae Maneaba in 17 feet of water mean low tide.

Didemnum (*Didemnum*) *moseleyi* (Herdman); *Polycarpa iwayamae* Tokioka.

Sta. GOC–39. 21 August. NW. Onotoa about 1,300 feet NE. from Namokoro, in an area of gravelly sand bottom with maximum depths of about 12–14 inches at low tide and with occasional heads of digitate *Porites lobata*.

Lissoclinum pulvinum (Tokioka).

Sta. GOC–41. 21 August. Green algal flats crusting dead coral, algal rock at NW. corner of Atoll. Collection was made over an area extending about 300 feet N. and 1,000 feet W. from a point 3,000 feet N. of the monument on Aonteuma. Area is exposed at low tide.

Lissoclinum pulvinum (Tokioka); *Trididemnum cyclops* Michaelsen; *T. savignii jolense* (Van Name).

Sta. GOC–44. 21 August. About 4,100 feet NNE. from monument on Aonteuma, NW. Onotoa. The area is one of gravel, sand veneered dead coral-algal bottom with occasional living digitate *Porites lobata*. Maximum depth at low tide is 10–12 inches.

Leptoclinum virens Hartmeyer.

Sta. GOC–51. 23 August. About 3¼ miles N. 31° W. from Tabuarorae Maneaba near the center of Te Rawa ni Bao, a pass in the S. part of the leeward reef. Collected from thickly set coral masses rising from 15 feet (sounded at low tide) of water to within about 8 to 10 feet of the surface locally.

Polycarpa cryptocarpa (Sluiter).

Sta. GOC.–53. 23 August. About 9,300 feet N. 30° W. from Tabuarorae Maneaba in S. part of Te Rawa Tekatobibi, a pass through the S. end of leeward reef. Collected from patch reefs rising to an occasional maximum of within 4 feet of the surface from a bottom sounded at 18 feet.

Polycarpa cryptocarpa (Sluiter).

Sta. GOC–55. 25 August. About 13,400 feet S. 75° W. from Aiaka Maneaba in the deep central part of the lagoon. The bottom is of low scattered dead and living coral patches on intervening limemud and limesand, about 30–40% sediments and 60–70% coral.

Didemnum (*Didemnum*) *candidum* Savigny; *D* (*?D.*) *macrospiculatum*, n. sp.; *D.* (*Polysyncraton*) *semifuscum* (Sluiter); *Eudistoma angolanum* (Michaelsen); *E. rubra* Tokioka; *Leptoclinides reticulatus* (Sluiter); *Microcosmus exasperatus* Heller; *Polycarpa cryptocarpa* (Sluiter); *Trididemnum savignii jolense* (Van Name).

Sta. GOC–59. 28 August. Approximately 1,400 feet due W. (S. 89° W.) from offshore end of Government station jetty, from a patch reef in the lagoon. Reef patch was about 200 feet in diameter rising from surrounding limesand bottom at roughly 2 fathoms (estimate) to within 5 feet of the surface (2 feet reduced to mean low tide).

Aplidium lobatum Savigny; *Botryllus tuberatus* Ritter and Forsyth; *Didemnum* (*Didemnum*) *candidum* Savigny; *Eudistoma pyriforme* (Herdman).

Sta. B–3. 8 August. South portion of northern main island, SW. from offshore end of Government station.
Amaroucium multiplicatum (Sluiter).

Sta. B–4. 8 August. Same data as B–3.
Amaroucium multiplicatum (Sluiter); *Didemnum* (*Didemnum*) *candidum* Savigny; *Polyclinum constellatum* Savigny.

Sta. B–5. 9 August. South portion of northern main island, NW. from offshore end of Government Station.
Lissoclinum pulvinum (Tokioka).

Sta. B–8. 15 August. Lagoon west of south end of northern main island.
Eudistoma angolanum (Michaelsen); *Polyclinum tsutsuii* Tokioka; *Trididemnum cyclops* Michaelsen.

Sta. A XVI. A. H. Banner, collector, 24 August.
Polycarpa melanosiphonica, n. sp.

——. 1 August. A. H. Banner, collector. *Heliopora* flat (tide pool 2 feet deep).
Trididemnum savignii jolense (Van Name).

——. 29 July. Living attached to dead coral. 10–20 feet deep. A. H. Banner, collector.
Polycarpa cryptocarpa (Sluiter).

Sta. MAC–2. 5 September 1951. Marshall Islands: Arno Atoll; about ¼ mile offshore lagoonward (NE.) from Ine settlement, Ine Island, at the outer edge of the lagoon reef. P. E. Cloud, collector.
Polycarpa iwayamae Tokioka.

The following species were contained in a collection received from Prof. T. Y. Chen, University of Amoy, China, 12 October 1932, USNM accession 121354, listing the material by station numbers but data have not been located:

Sta. 1. *Botryllus magnicoecus* (Hartmeyer).
Sta. 2. *Didemnum* (*Didemnum*) *dorotubu* Tokioka; *Microcosmus exasperatus* Heller.
Sta. 3. *Polyandrocarpa* (*Eusynstyela*) sp. aff. *monotestis* Tokioka.
Sta. 5. *Symplegma viride* Herdman.
Sta. 7. *Aplidiopsis amoyense*, n. sp.
Sta. 8. *Aplidiopsis amoyense*, n. sp.
Stas. 9–15. *Microcosmus exasperatus* Heller.

The following species were contained in a collection received 20 May 1924, from Dr. S. F. Light, University of Amoy, China. USNM accession 71777. Probably from the vicinity of Amoy, China:

Botryllus primigenus Oka; *B. tuberatus* Ritter and Forsyth; *Cnemidocarpa chinensis*, n. sp.; *Hartmeyeria chinensis*, n. sp.; *Microcosmus exasperatus* Heller.

The following species were contained in a collection made by Prof. E. S. Morse while teaching at the Imperial University of Tokyo, Japan, and sent to the U.S. National Museum (accession 52210) 7 December 1910, in exchange:

Hokkaido Island, Hakodate.
Amaroucium constellatum Verrill; *Aplidium yezoense*, n. sp.; *Botrylloides violaceus* Oka; *Corella japonica asamusi* Oka; *Molgula* (*Molgula*) *xenophora*

Oka; *Polycarpa psammotesta* Tokioka; *Ritterella* aff. *aequalisiphonis* (Ritter and Forsyth).

Otaru.

Amaroucium glabrum Verrill; *Chelyosoma siboja* Oka; *Cnemidocarpa macrogastra* (Oka); *Halocynthia aurantium* (Pallas); *Herdmania mirabilis* (v. Drasche); *Styela clava* Herdman; *Styela coriacea* (Alder and Hancock).

Kyushu Island, Kagoshima. *Hartmeyeria orientalis* Oka; *Herdmania momus* (Savigny).

Kobe. *Styela clava* Herdman.

Moji. *Hartmeyeria orientalis* Oka; *Herdmania momus* (Savigny).

Nagasaki. *Pyura sacciformis* (Drasche); *Styela clava* Herdman.

The following dredging and hydrographic stations were made by the United States Fish Commission Steamer *Albatross*. Listing the species contained therein:

Sta. 2093. 1 October 1883. 37°40′30″ N., 70°37′30″ W.; north Atlantic Ocean off Cape Hatteras.

Dolioletta gegenbauri tritonis (Herdman).

Sta. 2247. 27 September 1884. 40°03′00″ N., 69°57′00″ W., North Atlantic Ocean. Surface.

Doliolum denticulatum Quoy and Gaimard.

Sta. 2569. 31 August 1885. Surface. 39°26′00″ N., 68°03′30″ W., North Atlantic.

Doliolum denticulatum Quoy and Gaimard.

Sta. 3315. 15 August 1890. 54°02′40″ N., 166°42′00″ W., Bering Sea. 277 fathoms, green mud, sand.

Aplidium spitzbergense Hartmeyer.

Sta. 3684. 10 September 1899. 0°50′00″ N., 137°54′00″ W., off Marquesas. 2463 fathoms; gray yellow globigerina ooze.

Culeolus easteri, n. sp.

Sta. 3698. 5 May 1900. Off Honshu Island, Japan, bearing off Manazuru Zaki N. 8° W., 4.5 miles. 153 fathoms; green mud, volcanic ash, sand.

Cnemidocarpa fertilis (Hartmeyer); *Didemnum* (*Didemnum*) *siphonale*, n. sp.; *Herdmania momus* (Savigny); *Pyrosoma agassizi* Ritter and Byxbee; *Styela atlantica* (Van Name).

Sta. 3713. 11 May 1900. Off Honshu Island, Japan, bearing off Ose Zaki S. 81° W., 4.2 miles. 65 fathoms; volcanic sand, shells, rocks.

Pyura lepidoderma Tokioka.

Sta. 3714. 11 May 1900. Off Honshu Island, Japan, bearing off Ose Zaki S. 82° W., 3.3 miles. 48–60 fathoms; volcanic sand, shells, rocks.

Corella japonica Herdman.

Sta. 3717. 11 May 1900. Off Honshu Island, Japan, bearing off Ose Zaki S. 34° E., 0.8 miles. 63–100 fathoms; volcanic sand, shells, rocks.

Polycarpa psammotesta Tokioka.

Sta. 3724. 15 May 1900. Off Honshu Island, Japan, bearing off Noma Saki S. 86° E., 5.7 miles. 19–20 fathoms; mud, sand pebbles, shells.

Ascidia papillosa, n. sp.

Sta. 3725. 15 May 1900. Off Honshu Island, Japan, bearing off Noma Saki N. 18° E., 8.8 miles. 13 fathoms; volcanic sand, shells, rocks.

Corella japonica Herdman; *Trididemnum savignii* (Herdman).

Sta. 3727. 16 May 1900. Off Honshu Island, Japan, bearing off Omai Zaki Light N. 17° E., 9.7 miles. 34 fathoms; mud, coarse sand, black shells.

Didemnum (Didemnum) misakiense (Oka and Willey).

Sta. 3730. 16 May 1900. Off Honshu Island, Japan, bearing off Omai Zaki Light N. 17° E., 14.5 miles. 34–37 fathoms; mud, gravel, rock.

Eudistoma albatrossae, n. sp.; *Leptoclinum mitsukurii* (Oka); *Polyclinum constellatum* Savigny; *Syndiazona grandis* Oka.

Sta. 3745. 19 May 1900. Off Honshu Island, Japan, bearing off Suno Saki N. 89° E., 8.75 miles. 46–49 fathoms; gray sand, gravel.

Pyura sacciformis (Drasche).

Sta. 3872. Auau Channel, between Maui and Lanai Islands, Hawaiian Islands, bearing off Mokuhooniki Islet N. 3° E., 16.6 miles. 43–32 fathoms; yellow sand, pebbles, coral.

Leptoclinides hawaiiensis, n. sp.; *Trididemnum savignii* (Herdman).

Sta. 3875. Auau Channel between Maui and Lanai Islands, Hawaiian Islands, bearing off Mokuhooniki Islet N. 14°30′ E., 13.7 miles. 65–34 fathoms; fine gray sand.

Amaroucium pliciferum Redikorzev.

Sta. 3908. 5 May 1902. South coast of Oahu Island, Hawaiian Islands, bearing off Diamond Head Light N. 21° E., 6.9 miles. 304–308 fathoms; fine white sand, mud.

Styela izuana hawaiiensis, n. subsp.

Sta. 3970. 29 May 1902. French Frigate Shoal, Hawaiian Islands, 23°45′50″ N., 166°20′50″ W. 17–17½ fathoms; coarse sand, shells, coral.

Leptoclinides hawaiiensis, n. sp.

Sta. 4095. Northeast approach to Pailolo Channel between Maui and Molokai Islands, Hawaiian Islands, bearing off Mokuhooniki Islet S. 61° W., 10.6 miles. 290–286 fathoms; brown mud, fine sand, globigerina.

Styela izuana hawaiiensis, n. subsp.

Sta. 4709. 30 December 1904. South Pacific, 10°15′ S., 95°41′ W. 800 fathoms to surface.

Metcalfina hexagona (Quoy and Gaimard).

Sta. 4757. 4 May 1906. North Pacific, 39°18′ N., 123°58′ W., about 20 miles off the coast of California. Surface.

Doliolctta gegenbauri (Uljanin)?.

Sta. 4803. Tsugaru Strait, Japan, 41°35′50″ N., 140°36′45″ E., bearing off Cape Tsiuka S. 61° W., 10.6 miles. 47 fathoms; sand, shell, coarse gravel.

Amaroucium glabrum Verrill; *Didemnum (Didemnum) moseleyi* (Herdman).

Sta. 4876. 2 August 1906. Eastern Channel, Korea Straits, 34°20′ N., 130°10′ E., bearing off Oki Shima S. 29° W., 5.3 miles. 59 fathoms; fine gray sand, broken shells. Synoicidae.

Sta. 4889. 8 August 1906. Entrance to Eastern Sea, about 20 miles SW. of Nagasaki, Japan, 32°26′ N., 129°22′ E., bearing off Nomo Zaki N. 64° E., 20.5 miles. Surface.

Oikopleura (Coccaria) fusiformis Fol; *Oikopleura (Coecaria) longicauda* (Vogt).

Sta. 4987. 20 September 1906. In the Sea of Japan, 43°19′20″ N., 140°17′ E., bearing off Kamoi Misaki Light N. 76° S., 3.2 miles. 59 fathoms; rocky.

Didemnum (Didemnum) moseleyi (Herdman).

Sta. 4993. 22 September 1906. In the Sea of Japan, 45°25′30″ N., 140°53′ E., bearing off Bomasiri Shima N. 47° E., 5 miles. 142 fathoms; gray mud, sand, gravel.

Amaroucium glabrum Verrill.

Sta. 5025. 27 September 1906. Okhotsk Sea, off eastern coast Sakhalin Island, vicinity of Cape Patience, 48°43′30″ N., 144°56′45″ E., bearing off Flat Hill N. 45° W.; Cape Patience S. 68° W. 52 fathoms; pebbles.

Amaroucium glabrum Verrill.

Sta. 5064. 15 October 1906. In Suruga Gulf, Japan, 35°02′10″ N., 138°38′ E., bearing off Ose Saki S. 85½° E., 7.7 miles. 360 fathoms.

Dolioletta gegenbauri (Uljanin)?; *Doliolum denticulatum* Quoy and Gaimard.

———. 1906. Same, Mito, Japan.

Styela clara Herdman.

Sta. 5174. 5 March 1908. Philippine Islands, vicinity of Jolo, 6°03′45″ N., 120°57′ E., bearing off Jolo Light E., 2.60 miles. 20 fathoms; coarse sand.

Didemnum (Didemnum) misakiense (Oka and Willey); *Stolonica styeliformis* Van Name; *Trididemnum savignii* (Herdman).

———. 1908. 5 March. Philippine Islands, Jolo Island, Anchorage, electric light.

Salpa maxima tuberculata Metcalf.

Sta. 5195. 3 April 1908. Philippine Islands, off Northern Cebu Island, 10°47′ N., 124°06′30″ E., bearing off Capitancillo Island N., 11.75 miles. Surface.

Metcalfina hexagona (Quoy and Gaimard); *Thalia democratica orientalis* Tokioka.

Sta. 5233. 7 May 1908. Philippine Islands, between Bohol and Leyte 10°00′22″ N., 124°45′06″ E., bearing off Limasana Island S. 70° E., 19.50 miles. 100 fathoms.

Thalia democratica orientalis Tokioka.

Sta. 5363. 20 February 1909. Philippine Islands, Balayan Bay, 13°47′20″ N., 120°43′30″ E.

Metcalfina hexagona (Quoy and Gaimard).

Sta. 5370. 24 February 1909. Philippine Islands, Marinduque Island, 13°44′15″ N., 121°42′30″ E., bearing off Tayabas Light (outer) N. 32° W., 11.6 miles. 159 fathoms.

Iasis zonaria (Pallas).

Sta. 5456. 7 June 1909. Philippine Islands, east coast of Luzon, 13°11′10″ N., 123°51′52″ E., bearing off Legaspi Light S. 76° W., 6.7 miles.

Salpa cylindrica Cuvier.

Sta. 5483. 30 July 1909. Philippine Islands between Samar and Leyte, vicinity of Surigao Strait, bearing off Cabugan Grande Island (N.) N. 88° W., 5.7 miles. 74 fathoms; sand, broken shells.

Ciallusia longa Van Name.

Sta. 5558. 18 September 1909. Philippine Islands, off Jolo Island, 5°51′33″ N., 121°00′58″ E., bearing off Cabalian Point, S. 1.1 miles. 15 fathoms.

Ascidia sydneiensis samea (Oka).

Sta. 2627 (Hydrographic). 25 March 1891. North Pacific, 0°36′00″ N., 82°45′00″ W. Surface to 1740 fathoms.

Dolioletta gegenbauri (Uljanin)?; *D. g. tritonis* (Herdman).

Sta. 2708 (Hydrographic) surface station 54. 14 October 1891. North Pacific, 35°03′30″ N., 129°05′00″ W. Surface.

Doliolum denticulatum Quoy and Gaimard; *D. nationalis* Borgert.

Sta. 2709 (Hydrographic) surface station 55. 14 October 1891. North Pacific 34°56′30″ N., 129°20′00″ W. Surface.

Doliolina intermedium (Neumann); *Dolioletta gegenbauri tritonis* (Herdman).

——. Gulf of California, off Guaymas, Mexico. 189?. Surface to 500 fathoms.

Dolioletta gegenbauri (Uljanin)?

——. North Pacific, 12°34°00″ N., 97°21′00″ W.; 189?.

Dolioletta gegenbauri (Uljanin)?.

——. Japan, Hokkaido Island, Otaru.

Halocynthia roretzi (v. Drasche).

The following stations were contained in a collection made by the U.S. Fisheries Schooner *Grampus:*

Sta. 9 (tow net). February 15 to March 27, 1889. Off the west coast of Florida, Gulf of Mexico.

Dolioletta gegenbauri (Uljanin)?; *D. g.* (U.); *Doliolum nationalis* Borgert.

Sta. 5078. 1 March 1889. 25°34′00″ N., 83°07′00″ W. Off Tortugas, Florida. Gulf of Mexico. 30 fathoms.

Clavelina (*Synclavella*) *gigantea* Van Name.

The following species were contained in miscellaneous USNM accessions:

Acc. 84701. China, Shanghai. Early summer 1924. A. de C. Sowerby, collector, no. 827.

Styela clava Herdman.

Acc. 63417. China, Chefoo. C. Ping, collector.

Styela clava Herdman.

——. China or Japan; from the bottom of the USS *Palos* after a voyage across the Pacific. P. L. Jouy no. 2479.

Styela plicata (Lesueur).

Acc. 71873. Thailand, Langsuen; from a bamboo stake. H. M. Smith, collector.

Leptoclinum mitsukurii (Oka); *Symplegma viride* Herdman.

Acc. 106702. Burma, Rangoon. G. E. Gates, collector.

Botryllus compositus, n. sp.

Acc. 99399. 17 April 1929. Philippine Islands: Talisay, Cebu. Eclipse Expedition, USN, H. C. Kellers, collector.

Didemnum (*Didemnum*) *candidum* (Savigny).

Acc. 200652. 21 October 1953. Caroline Islands: Ifaluk Atoll, lagoon shore off Middle Ella. Depth 1½ fathoms. Sta. 714. F. M. Bayer, collector. Attached to coral.

Polycarpa aurata (Quoy and Gaimard).

Acc. 168945. 17 October 1944. Solomon Islands: New Georgia Island, Cliff 5 feet below surface near Munda Airport. Sta. 38. W.G. Iltis, collector.

Polycarpa cryptocarpa (Sluiter).

Acc. 205840. 20 July 1954. Caroline Islands: Kapingamarangi, lagoon reef Hare. Sta. 333. Cadet Hand, collector.

Ascidia gemmata Sluiter.

Acc. 190125. 21 July 1950. Marshall Islands: Arno Atoll, lagoon off Ine Village. Sta. 33. John W. Wells, collector.

Polycarpa iwayamae Tokioka.

Acc. 172586. 12 July 1946. Marshall Islands: Rongelap Atoll, Naen Island; below low tide in lagoon. M. W. Johnson, collector.

Ascidia aperta Sluiter.

——. 29 March 1946. Bikini Atoll, Bikini Lagoon; 180–200 feet. Sta. S–46–44. L. P. Schultz, "Crossroads Expedition," collector.

Polycarpa cryptocarpa (Sluiter).

Acc. 187437. 5 July 1949. Marshall Islands: Ebon Atoll, Pearl pool. Sta. M–139. M. W. de Laubenfels, collector.

Leptoclinum virens Hartmeyer.

Acc. 163260 (old transportation number). Wake Island. Received from C. H. Edmondson, University of Hawaii, 15 February 1924.

No. 606. *Ascidia gemmata* Sluiter; No. 607. *Microcosmus curvus* Tokioka; No. 608. *M.c.*T; No. 613. *Perophora formosana* (Oka).

Acc. 117224. 8 August 1930. Hawaiian Islands: Pearl and Hermes Reef. Sta. T.H. 60. Received from P. S. Galtsoff.

Didemnum (Didemnum) candidum (Savigny).

——. September 1920, Hawaiian Islands: Pearl Harbor. Paul Bartsch, collector.

Polyclinum vasculosum Pizon.

——. Hawaiian Islands: Oahu. T. H. Streets, collector.

Polyclinum vasculosum Pizon.

Acc. 128938. 25 January 1934. Galapagos Islands: Cartage Bay, Albemarle Island. Sta. 189. Allan Hancock Galapagos Expedition, Bob Irwin and H. W. Manter, collectors.

Didemnum (Didemnum) candidum (Savigny).

——. January 1875, New Zealand, Port Chalmers, Navy's Transit of the *Venus* Expedition, Dr. E. Kerschner, collector.

Pyura pachydermatina (Herdman).

——. Australia, Port Jackson, North Pacific Exploring Expedition, William Stimpson, collector, sta. S.H. 142. 1853–1856.

Cnemidocarpa personata (Herdman); *Didemnum (Didemnum) moseleyi* (Herdman); *Herdmania momus grandis* (Heller); *Microcosmus exasperatus* Heller.

Ac. 177438. Antarctica. Caught on the surface of the ocean off Knox Coast. U.S. Navy Antarctic Expedition "Windmill" 1947-1948, Mr. Layton, collector, stas. 106 and 107.

Distaplia cylindrica (Lesson) f. *typica*.

Acc. 197052. Gulf of Mexico, off Englewood, Florida, 27°1.7′ N., 82°40.1′ W. Robert Stewart, collector; 3 January 1952, Sta. B–47=D–9, coarse gray sand, shells, coral.

Trididemnum savignii jolense (Van Name).

Of the approximately 400 specimens dissected for detailed examination, 117 species and varieties of ascidians and 13 of pelagic tunicates were identified, as follows:

ASCIDIACEA

Order Aplousobranchia

Family Synoicidae

1. *Aplidium lobatum* Savigny. Gilbert, Palau, Marianas.
1a. *Aplidium* sp. aff. *lobatum* Savigny. Marianas.
2. *Aplidium* sp. aff. *depressum* Sluiter. Philippines.
3. *Aplidium spitzbergense* Hartmeyer. Bering Sea.
4. *Aplidium yezoense*, new species. Japan.
5. *Amaroucium constellatum* Verrill. Japan.
6. *Amaroucium glabrum* Verrill. Japan, Russia (Okhotsk Sea).
7. *Amaroucium pliciferum* Redikorzev. Hawaii.
8. *Amaroucium* sp. aff. *monotonicum* Tokioka. Palau.
9. *Amaroucium multiplicatum* (Sluiter). Gilbert, Palau.
10. *Amaroucium crateriferum* Sluiter. Palau.
11. *Amaroucium constrictum* Sluiter. Palau.
12. *Aplidiopsis amoyense*, new species. China.
13. *Polyclinum tsutsuii* Tokioka. Gilbert, Palau, Philippines.
14. *Polyclinum vasculosum* Pizon. Hawaii, Philippines, Marianas.
15. *Polyclinum constellatum* Savigny. Palau, Gilbert, Japan.
16. *Ritterella* sp. aff. *aequalisiphonis* (Ritter & Forsyth). Japan.
17. *Euherdmania digitata* Millar. Palau.
18. Polyclinid in strobilization (?). Korea Straits.

Family Didemnidae

19. *Didemnum* (*Didemnum*) *candidum* Savigny. Philippines, Gilbert, Hawaii, Galapagos, Palau.
20. *Didemnum* (*Didemnum*) *moseleyi* (Herdman). Australia, Gilbert, Japan, Palau, Philippines.
20a. *Didemnum* (*Didemnum*) *moseleyi* f. *granulatum* Tokioka. Palau.
21. *Didemnum* (*Didemnum*) *nekozita*, new species. Palau, Philippines.
22. *Didemnum* (*Didemnum*) *sphaericum*, new species. Palau.
23. *Didemnum* (?*Didemnum*) *macrospiculatum*, new species. Gilbert.
24. *Didemnum* (*Didemnum*) *siphonale*, new species. Japan.
25. *Didemnum* (*Didemnum*) *dorotubu*, new name. China, Philippines.
26. *Didemnum* (*Didemnum*) *misakiense* (Oka & Willey). Japan, Philippines.
27. *Didemnum* (*Didemnum*) *ternatanum* (Gottschaldt). Palau, Philippines.
28. *Didemnum* (*Polysyncraton*) *sagamiana* Tokioka. Palau.
29. *Didemnum* (*Polysyncraton*) *semifuscum* (Sluiter). Gilbert.
30. *Trididemnum savignii* (Herdman). Hawaii, Palau, Marianas, Philippines, Japan.
31. *Trididemnum savignii* var. *jolense* (Van Name). Gilbert, Palau, Philippines, Gulf of Mexico.
32. *Trididemnum cyclops* Michaelsen. Gilbert.
33. *Trididemnum viride* (Herdman). Philippines.
34. *Leptoclinides reticulatus* (Sluiter). Palau, Gilbert.
35. *Leptoclinides hawaiiensis*, new species. Hawaii.
36. *Echinoclinum philippinense*, new species. Philippines.
37. *Lissoclinum fragile* (Van Name). Palau, Philippines.
38. *Lissoclinum molle* (Herdman). Palau.
39. *Lissoclinum patella* (Gottschaldt). Palau, Philippines.

40. *Lissoclinum pulvinum* (Tokioka). Gilbert, Palau, Philippines.
41. *Leptoclinum virens* Hartmeyer. Gilbert, Marshall, Palau, Philippines.
42. *Leptoclinum mitsukurii* (Oka). Japan, Thailand.
42a. *Leptoclinum* sp. Philippines.

Family Polycitoridae

43. *Clavelina fecunda* (Sluiter). Palau.
44. *Clavelina molluccensis* (Sluiter). Palau.
45. *Clavelina* (*Synclavella*) *arafurensis* Tokioka. Palau.
46. *Clavelina* (*Synclavella*) *gigantea* Van Name. West Indies.
47. *Eudistoma pyriforme* (Herdman). Palau, Gilbert.
48. *Eudistoma angolanum* (Michaelsen). Gilbert, Marianas.
48a. *Eudistoma* sp. aff. *angolanum* (Michaelsen). Palau.
49. *Eudistoma rubrum* Tokioka. Gilbert.
50. *?Eudistoma tokarae* Tokioka. Philippines.
51. *Eudistoma laysani* (Sluiter). Palau.
52. *Eudistoma amplum* (Sluiter). Palau.
53. *Eudistoma viride* Tokioka. Palau.
54. *Eudistoma marianense*, new species. Marianas.
55. *Eudistoma albatrossae*, new species. Japan.
56. *Hypodistoma vastum* (Millar), new genus. Palau.
57. *Distaplia mikropnoa* (Sluiter). Palau.
58. *Distaplia cylindrica* (Lesson) f. *typica*. Antarctica.

Order PHLEBOBRANCHIA

Family Diazonidae

59. *Syndiazona grandis* Oka. Japan.

Family Cionidae

60. *Ciallusia longa* Van Name. Philippines.

Family Perophoridae

61. *Perophora formosana* (Oka). Palau, Wake.
62. *Perophora* sp. Philippines.
63. *Ecteinascidia imperfecta* Tokioka. Palau.

Family Ascidiidae

64. *Ascidia sydneiensis samea* (Oka). Philippines.
65. *Ascidia gemmata* Sluiter. Marianas, Carolines, Wake.
66. *Ascidia minuta* Tokioka. Palau.
67. *Ascidia aperta* Sluiter. Marshall.
68. *Ascidia papillosa*, new species. Japan.
69. *Phallusia julinea* Sluiter. Palau.

Family Rhodosomatidae

70. *Corella japonica* Herdman. Japan.
71. *Corella japonica* var. *asamusi* Oka. Japan.
72. *Chelyosoma siboja* Oka. Japan.

Order STOLIDOBRANCHIA

Family Botryllidae

73. *Botryllus primigenus* Oka. China, Palau.
74. *Botryllus tuberatus* Ritter & Forsyth. Palau, China, Gilbert.

75. *Botryllus magnicoecus* (Hartmeyer). China.
76. *Botryllus compositus*, new species. Burma.
77. *Botrylloides tyreum* Herdman. Palau.
78. *Botrylloides violaceus* Oka. Palau, Japan.
79. *Botrylloides violaceus marginatus*, new subspecies. Palau.

Family Styelidae

80. *Symplegma viride* Herdman. China, Thailand, Palau.
81. *Stolonica styeliformis* Van Name. Philippines.
82. *Polyandrocarpa* (*Eusynstyela*) sp. aff. *monotestis* Tokioka. China.
83. *Polycarpa aurata* (Quoy & Gaimard). Carolines.
84. ?*Polycarpa quadrata* Herdman. Palau.
85. *Polycarpa captiosa* (Sluiter). Palau, Marianas.
86. *Polycarpa cryptocarpa* (Sluiter). Gilbert, Marshall, Palau, Solomons.
87. *Polycarpa iwayamae* Tokioka. Gilbert, Marshall, Palau.
88. *Polycarpa psammotesta* Tokioka. Japan.
89. *Polycarpa melanosiphonica*, new species. Gilbert, Marianas.
90. *Polycarpa* sp. Palau.
91. *Cnemidocarpa areolata* (Heller). Marianas.
92. *Cnemidocarpa fertilis* (Hartmeyer). Japan.
93. *Cnemidocarpa macrogastra* (Oka). Japan.
94. *Cnemidocarpa personata* (Herdman). Australia.
95. *Cnemidocarpa incubita* (Sluiter). Marianas.
96. *Cnemidocarpa chinensis*, new species. China.
97. *Styela plicata* (Lesueur). China or Japan.
98. *Styela clava* (Herdman). China, Japan.
99. *Styela atlantica* (Van Name). Japan.
100. *Styela izuana hawaiiensis*, new subspecies. Hawaii.
101. *Styela coriacea* (Alder & Hancock). Japan.

Family Pyuridae

102. *Pyura sacciformis* (Von Drasche). Japan.
103. *Pyura lepidoderma* Tokioka. Japan.
104. *Pyura curvigona* Tokioka. Palau.
105. *Pyura vittata* (Stimpson). Palau.
106. *Pyura pachydermatina* (Herdman). New Zealand.
107. *Herdmania mirabilis* (Von Drasche). Japan.
108. *Herdmania momus* (Savigny). Marianas, Japan.
109. *Herdmania momus* var. *grandis* (Heller). Australia.
110. *Microcosmus exasperatus* Heller. China, Marianas, Gilberts, Australia.
111. *Microcosmus curvus* Tokioka. Wake, Marianas, Palau.
112. *Halocynthia roretzi* (von Drasche). Japan.
113. *Halocynthia aurantium* (Pallas). Japan.
114. *Culeolus casteri*, new species. Marquesas.

Family Molgulidae

115. *Molgula* (*Molgula*) *xenophora* Oka. Japan.
116. *Hartmeyeria orientalis* Oka. Japan.
117. *Hartmeyeria chinensis*, new species. China.

APPENDICULARIA

Family Oikopleuridae

118. *Oikopleura* (*Coccaria*) *longicauda* (Vogt). Japan.
119. *Oikopleura* (*Coccaria*) *fusiformis* Fol. Japan.

THALIACEA

Family Doliolidae

120. *Doliolum denticulatum* Quoy & Gaimard. Pacific, Japan, North Atlantic.
121. *Doliolum nationalis* Borgert. Pacific, Gulf of Mexico.
122. *Dolioletta gegenbauri* (Uljanin). Gulf of Mexico, Eastern Pacific, Gulf of California.
123. *Dolioletta gegenbauri tritonis* (Herdman). Pacific, North Atlantic.
124. *Doliolina intermedium* (Neumann). North Pacific, Gulf of Mexico.

Family Salpidae

125. *Salpa maxima* var. *tuberculata* Metcalf. Philippines.
126. *Salpa cylindrica* Cuvier. Philippines.
127. *Iasis zonaria* (Pallas). Philippines.
128. *Metcalfina hexagona* (Quoy & Gaimard). Philippines, South Pacific.
129. *Thalia democratica* var. *orientalis* Tokioka. Philippines.

PYROSOMATA

Family Pyrosomidae

130. *Pyrosoma agassizi* Ritter & Byxbee. Japan.

Of the species identified, 16 are considered to be new species and 2 are new subspecies; one new genus is proposed. All the abovementioned ascidians are divided faunistically as follows:

Subarctic waters (1 species)

3. *Aplidium spitzbergense* Hartmeyer. Bering Sea.

Japanese waters (32 species)

4. *Aplidium yezoense*, new species. Hakodate.
5. *Amaroucium constellatum* Verrill. Hakodate.
6. *Amaroucium glabrum* Verrill. Hokkaido.
15. *Polyclinum constellatum* Savigny.
16. *Ritterella* sp. aff. *aequalisiphonis* (Ritter & Forsyth). Hakodate.
18. Polyclinid in strobilization (?).
20. *Didemnum* (*Didemnum*) *moseleyi* (Herdman).
24. *Didemnum* (*Didemnum*) *siphonale*, new species.
26. *Didemnum* (*Didemnum*) *misakiense* (Oka & Willey).
30. *Trididemnum savignii* (Herdman).
42. *Leptoclinum mitsukurii* (Oka).
55. *Eudistoma albatrossae*, new species.
59. *Syndiazona grandis* Oka.
68. *Ascidia papillosa*, new species.
70. *Corella japonica* Herdman.
71. *Corella japonica* var. *asamusi* Oka. Hakodate.
72. *Chelyosoma siboja* Oka. Otaru.
78. *Botrylloides violaceus* Oka. Hakodate.
88. *Polycarpa psammotesta* Tokioka. Hakodate.
92. *Cnemidocarpa fertilis* (Hartmeyer).
93. *Cnemidocarpa macrogastra* (Oka). Otaru.
98. *Styela clava* Herdman. Same, Wakaura, Nagasaki.
99. *Styela atlantica* (Van Name).
101. *Styela coriacea* (Adler & Hancock). Otaru.
102. *Pyura sacciformis* (von Drasche). Nagasaki.
103. *Pyura lepidoderma* Tokioka.

107. *Herdmania mirabilis* (von Drasche). Hakodate.
108. *Herdmania momus* (Savigny). Kagoshima, Moji.
112. *Halocynthia roretzi* (von Drasche). Otaru.
113. *Halocynthia aurantium* (Pallas). Otaru.
115. *Molgula* (*Molgula*) *renophora* Okla. Hakodate.
116. *Hartmeyeria orientalis* Oka. Moji, Kagoshima.

Chinese waters (12 species)

12. *Aplidiopsis amoyense*, new species. Amoy.
25. *Didemnum* (*Didemnum*) *dorotubu*, new name. Amoy.
73. *Botryllus primigenus* Oka. Amoy.
74. *Botryllus tuberatus* Ritter & Forsyth. Amoy.
75. *Botryllus magnicoccus* (Hartmeyer). Amoy.
80. *Symplegma viride* Herdman. Amoy.
82. *Polyandrocarpa* (*Eusynstyela*) sp. aff. *monotestis* Tokioka. Amoy.
96. *Cnemidocarpa chinensis*, new species. Amoy.
97. *Styela plicata* (Lesueur).
98. *Styela clava* Herdman. Chefoo.
110. *Microcosmus exasperatus* (Heller). Amoy.
117. *Hartmeyeria chinensis*, new species. Amoy.

Philippine Islands (23 species)

2. *Aplidium* sp. aff. *depressum* Sluiter.
13. *Polyclinum tsutsuii* Tokioka.
14. *Polyclinum vasculosum* Pizon.
19. *Didemnum* (*Didemnum*) *candidum* (Savigny).
20. *Didemnum* (*Didemnum*) *moseleyi* (Herdman).
21. *Didemnum* (*Didemnum*) *nekozita*, new species.
25. *Didemnum* (*Didemnum*) *dorotubu*, new name.
26. *Didemnum* (*Didemnum*) Misakiense (Oka & Willey).
27. *Didemnum* (*Didemnum*) *ternatanum* (Gottschaldt).
30. *Trididemnum savignii* (Herdman).
31. *Trididemnum savignii* var. *jolense* (Van Name).
33. *Trididemnum viride* (Herdman).
36. *Echinoclinum philippinense*, new species.
37. *Lissoclinum fragile* (Van Name).
39. *Lissoclinum patella* (Gottschaldt).
40. *Lissoclinum pulvinum* (Tokioka).
41. *Leptoclinum virens* Hartmeyer.
42a. *Leptoclinum* sp.
50. ?*Eudistoma tokarae* Tokioka.
60. *Ciallusia longa* Van Name.
62. *Perophora* sp.
64. *Ascidia sydneiensis samea* (Oka).
81. *Stolonica styeliformis* Van Name.

Thailand (2 species)

42. *Leptoclinum mitsukurii* (Oka).
80. *Symplegma viride* Herdman.

Burma (1 species)

76. *Botryllus compositus*, new species.

Saipan Island (14 species)

1. *Aplidium lobatum* Savigny.
1a. *Aplidium* sp. aff. *lobatum* Savigny.

14. *Polyclinum vasculosum* Pizon.
30. *Trididemnum savignii* (Herdman).
48. *Eudistoma angolanum* (Michaelsen).
54. *Eudistoma marianense*, new species.
65. *Ascidia gemmata* Sluiter.
85. *Polycarpa captiosa* (Sluiter).
89. *Polycarpa melanosiphonica*, new species.
91. *Cnemidocarpa areolata* (Heller).
95. *Cnemidocarpa incubita* (Sluiter).
108. *Herdmania momus* (Savigny).
110. *Microcosmus exasperatus* Heller.
111. *Microcosmus curvus* Tokioka.

Palau Islands and other localities in the Caroline Islands (53 species)

1. *Aplidium lobatum* Savigny.
8. *Amaroucium* sp. aff. *monotonicum* Tokioka.
9. *Amaroucium multiplicatum* (Sluiter).
10. *Amaroucium crateriferum* Sluiter.
11. *Amaroucium constrictum* Sluiter.
13. *Polyclinum tsutsuii* Tokioka.
15. *Polyclinum constellatum* Savigny.
17. *Euherdmania digitata* Millar.
19. *Didemnum* (*Didemnum*) *candidum* Savigny.
20. *Didemnum* (*Didemnum*) *moseleyi* (Herdman).
20a. *Didemnum* (*Didemnum*) *moseleyi* f. *granulatum* Tokioka.
21. *Didemnum* (*Didemnum*) *nekozita*, new species.
22. *Didemnum* (*Didemnum*) *sphaericum*, new species.
27. *Didemnum* (*Didemnum*) *ternatanum* (Gottschaldt).
28. *Didemnum* (*Polysyncraton*) *sagamiana* Tokioka.
30. *Trididemnum savignii* (Herdman).
31. *Trididemnum savignii* var. *jolense* (Van Name).
34. *Leptoclinides reticulatus* (Sluiter).
37. *Lissoclinum fragile* (Van Name).
38. *Lissoclinum molle* (Herdman).
39. *Lissoclinum patella* (Gottschaldt).
40. *Lissoclinum pulvinum* (Tokioka).
41. *Leptoclinum virens* Hartmeyer.
43. *Clavelina fecunda* (Sluiter).
44. *Clavelina moluccensis* (Sluiter).
45. *Clavelina* (*Synclavella*) *arafurensis* Tokioka.
47. *Eudistoma pyriforme* (Herdman).
48a. *Eudistoma* sp. aff. *angolanum* (Michaelsen).
51. *Eudistoma laysani* (Sluiter).
52. *Eudistoma amplum* (Sluiter).
53. *Eudistoma viride* Tokioka.
56. *Hypodistoma vastum* (Millar).
57. *Distaplia mikropnoa* (Sluiter).
61. *Perophora formosana* (Oka).
63. *Ecteinascidia imperfecta* Tokioka.
65. *Ascidia gemmata* Sluiter. Kapingamarangi Atoll.
66. *Ascidia minuta* Tokioka.
69. *Phallusia julinea* Sluiter.
73. *Botryllus primigenus* Oka.

74. *Botryllus tuberatus* Ritter & Forsyth.
77. *Botrylloides tyreum* Herdman.
78. *Botrylloides violaceus* Oka.
79. *Botrylloides violaceus marginatus*, new subspecies.
80. *Symplegma viride* Herdman.
83. *Polycarpa aurata* (Quoy & Gaimard). Ifaluk Atoll.
84. ?*Polycarpa quadrata* Herdman.
85. *Polycarpa captiosa* (Sluiter).
86. *Polycarpa cryptocarpa* (Sluiter).
87. *Polycarpa iwayamae* Tokioka.
90. *Polycarpa* sp.
104. *Pyura curvigona* Tokioka.
105. *Pyura vittata* (Stimpson).
111. *Microcosmus curvus* Tokioka.

Marshall Islands (4 species)

41. *Leptoclinum virens Hartmeyer.* Ebon Atoll.
67. *Ascidia aperta* Sluiter. Rongelap Atoll.
86. *Polycarpa cryptocarpa* (Sluiter). Bikini Atoll.
87. *Polycarpa iwayamae* Tokioka. Arno Atoll.

Gilbert and Solomon Islands (21 species)

1. *Aplidium lobatum* Savigny.
9. *Amaroucium multiplicatum* (Sluiter).
13. *Polyclinum tsutsuii* Tokioka.
15. *Polyclinum constellatum* Savigny.
19. *Didemnum* (*Didemnum*) *candidum* Savigny.
20. *Didemnum* (*Didemnum*) *moseleyi* (Herdman).
23. *Didemnum* (?*Didemnum*) *macrospiculatum*, new species.
29. *Didemnum* (*Polysyncraton*) *semifuscum* (Sluiter).
31. *Trididemnum savignii* var. *jolense* (Van Name).
32. *Trididemnum cyclops* Michaelsen.
34. *Leptoclinides reticulatus* (Sluiter).
40. *Lissoclinum pulvinum* (Tokioka).
41. *Leptoclinum virens* Hartmeyer.
47. ?*Eudistoma pyriforme* (Herdman).
48. *Eudistoma angolanum* (Michaelsen).
49. *Eudistoma rubrum* Tokioka.
74. *Botryllus tuberatus* Ritter & Forsyth.
86. *Polycarpa cryptocarpa* (Sluiter). Gilbert, New Georgia.
87. *Polycarpa iwayamae* Tokioka.
89. *Polycarpa melanosiphonica*, new species.
110. *Microcosmus exasperatus* Heller.

Wake Island (3 species)

61. *Perophora formosana* (Oka).
65. *Ascidia gemmata* Sluiter.
111. *Microcosmus curvus* Tokioka.

Hawaiian Islands (6 species)

7. *Amaroucium pliciferum* Redikorzev.
14. *Polyclinum vasculosum* Pizon.
19. *Didemnum* (*Didemnum*) *candidum* Savigny.

30. *Trididemnum savignii* (Herdman).
35. *Leptoclinides hawaiiensis*, new species.
100. *Styela izuana hawaiiensis*, new subspecies.

Galapagos Islands (1 species)

19. *Didemnum* (*Didemnum*) *candidum* Savigny.

Near Easter Island (1 species)

114. *Culeolus easteri*, new species.

Australia (Port Jackson) (4 species)

20. *Didemnum* (*Didemnum*) *moseleyi* (Herdman).
94. *Cnemidocarpa personata* (Herdman)
109. *Herdmania momus var. grandis* (Heller).
110. *Microcosmus exasperatus* Heller.

New Zealand (Port Bhalmers) (1 species)

106. *Pyura pachydermatina* (Herdman).

Antarctica (1 species)

58. *Distaplia cylindrica* (Lesson) f. *typica*.

Florida (2 species)

31. *Trididemnum savignii* var. *jolense* (Van Name).
46. *Clavelina* (*Synclavella*) *gigantea* Van Name.

The manuscript of this paper was completed at the end of 1959. After it was submitted for publication, additions were made that included papers appearing up to 1961. Since then, however, a number of papers have been published on the taxonomy of ascidians, of which the following concerned with the Pacific ascidians may be important:

KOTT, P.

1962. The ascidians of Australia. III. Aplousobranchiata Lahille: Didemnidae Giard. Australian Journ. Mar. Freshwater Res., vol. 13, no. 3, pp. 265–334, 49 text-figs.

1963. The ascidians of Australia. IV. Aplousobranchiata Lahille: Polyclinidae Verrill (continued). Australian Journ. Mar. Freshwater Res., vol. 14, no. 1, pp. 70–118, 27 text-figs.

MILLAR, R. H.

1962. Further descriptions of South African ascidians. Ann. South African Mus., vol. 46, part 7, pp. 113–221, 45 text-figs.

1963a. The structure and relationships of the ascidian *Ciallusia longa* Van Name. Proc. Zool. Soc. London, vol. 141, part 3, pp. 623–628, 3 text-figs.

1963b. Australian ascidians in the British Museum (Natural History). Proc. Zool. Soc. London, vol. 141, part 4, pp. 689–746, 47 text-figs.

TOKIOKA, T.

1965. Questions concerning the diagnoses of some ascidian genera. Publ. Seto Mar. Biol. Lab., vol. 13, no. 2, pp. 125–129.

Since it would have been difficult to insert in the present paper all the synonyms and supplementary notes in those papers concerning the species here treated, only the most significant have been noted herein.

ASCIDIACEA

Order Aplousobranchia: Family Synoicidae

1. *Aplidium lobatum* Savigny

FIGURES 1*a–f*

Aplidium lobatum Savigny, 1816, p. 182, pl. 3, fig. 4, pl. 16, fig. 1.—Van Name, 1921, p. 203, fig. 3.—Van Name, 1930, p. 425, fig. 4.—Van Name, 1945, p. 28, fig. 3.—Tokioka, 1955, p. 43, pl. 1, figs. 1–5.

Aplidium tremulum Savigny, 1816, p. 184, pl. 16, fig. 2.—Sluiter, 1909, p. 99.

MATERIAL EXAMINED

MARIANAS ISLANDS, Saipan: P. E. Cloud, sta. D–8. One colony, 9 mm. × 5 mm. in extent and 2.5 mm. in thickness. White sand grains densely cover the surface of the colony and also impregnate the test. The zooids are preserved very poorly (USNM 11471).

PALAU ISLANDS, Iwayama Bay: GVF sta. 30. Two small colonies, 6 mm. × 5 mm. and 7 mm. × 4 mm. in extent and up to 2.5 mm. in thickness. They are attached to algae and contain minute sand grains embedded in the test. The zooids are strongly contracted (USNM 11459).

GILBERT ISLANDS, Onotoa Atoll: P. E. Cloud, sta. GOC–59. A small colony, 6 mm. × 2 mm. in extent, attached to a colony of *Didemnum* (*Didemnum*) *candidum* (Savigny), and densely covered with sand grains over its surface; sand grains also impregnate the test densely throughout, from the surface to the interior. The colony is considerably mutilated and the zooids are also preserved somewhat poorly (USNM 11514).

DESCRIPTION.—Test soft, transparent or translucent, quite colorless or faintly yellowish brown. Due to imperfect state of preservation system of zooid arrangement is hardly observable on surface; only a single central common cloacal aperture can be seen on the specimen from Saipan, and on one of the specimens from the Palau Islands. Common cloacal aperture about 2 mm. in diameter, margin fringed with 14 finger-shaped lobules on the Saipan specimen (fig. 1*d*). Zooids about 1 mm. in length, in a strongly contracted state (fig. 1*a*). In contracted condition, thorax about 1.5 times length of abdomen; branchial aperture 6-lobed, tip of atrial languet simple or trifid; 6 to 10 strong longitudinal muscles on each side of thorax; 6 to 9 stigmatal rows. Stomach situated nearly at middle of abdomen, with 5 longitudinal plications including typhlosole. Proximal end of rectum constricted distinctly from the foregoing part of alimentary canal, may show a pair of slightly swollen caeca in those zooids in better condition. About 3 stigmatal rows posterior to level of anus. Gonads not found in any of the zooids examined.

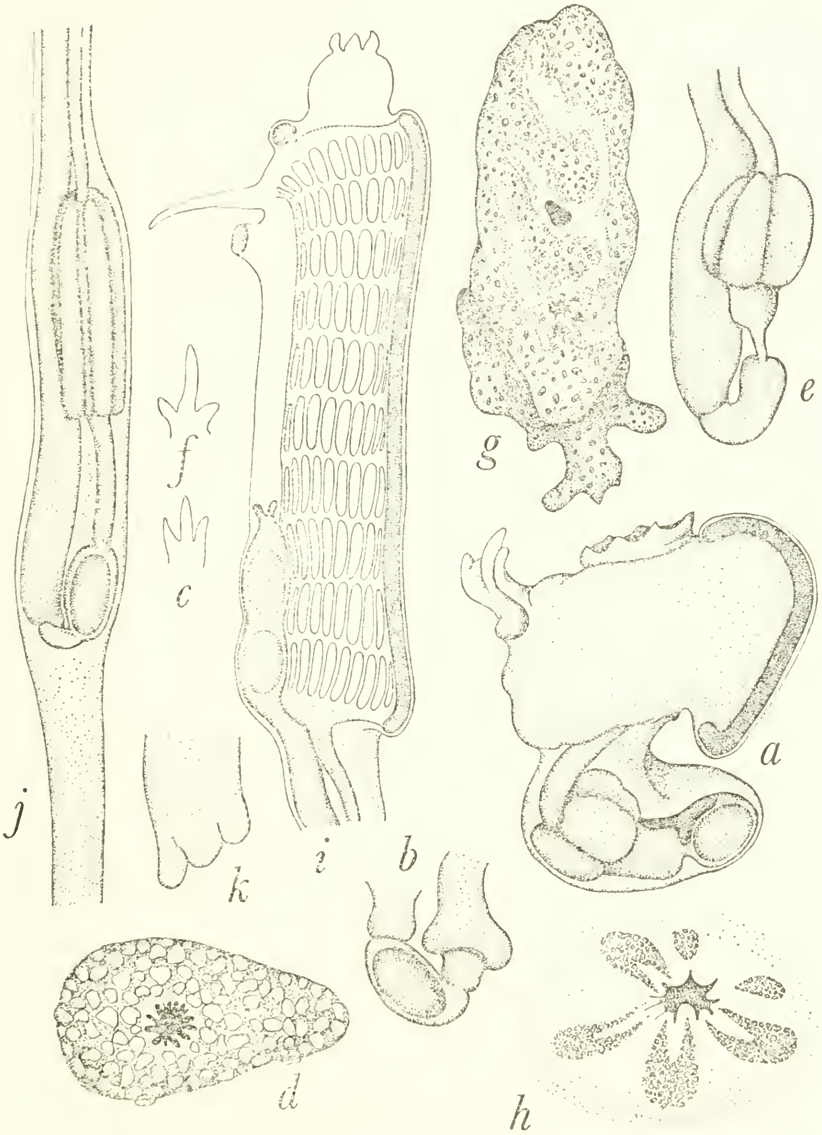

FIGURE 1.—*a–f*, *Aplidium lobatum* Savigny: *a*, contracted zooid of colony from Palau Islands; *b*, posterior part of intestinal loop of a zooid of same colony; *c*, tip of atrial languet of same zooid; *d*, colony from Saipan Island; *e*, intestinal loop of a zooid of same colony; *f*, tip of atrial languet of same zooid. *g–k*, *Aplidium* sp. aff. *lobatum*: *g*, upper side of colony; *h*, common cloacal aperture, with small patches of embedded sand grains surrounding aperture; *i*, right side of thorax; *j*, abdomen; *k*, proximal end of rectum, showing a pair of inconspicuous caeca.

1a. *Aplidium* sp. aff. *lobatum* Savigny

FIGURES 1*g–k*

MATERIAL EXAMINED

MARIANAS ISLANDS, Saipan: P. E. Cloud, sta. E-7. A single colony, 15 mm.× 8 mm. in extent and 3 mm. in thickness, attached to coral rock (USNM 11506).

DESCRIPTION.—Test rather transparent, quite colorless, embedded with white sand grains. Lacunar system complicated, can be seen through test, clearly defined by absence of whitish sand grains as well as by presence of brownish fecal pellets cast out along sides of lacunae. Two common cloacal apertures on surface, one with simple margin, the other with about 10 marginal lobules, surrounded by several small patches of embedded sand grains (fig. 1*h*). Zooids usually brownish in color. Postabdomen lost in most zooids. Length reaching about 3 mm. including postabdomen. Abdomen about two-thirds the length of thorax, postabdomen nearly as long as thorax. Branchial aperture 6-lobed, atrial aperture opening at tip of a short siphon projecting from level of third stigmatal row, with simple atrial languet at anterior base of atrial siphon. About 10 strong longitudinal muscles on each side of thorax. Stigmatal rows present 10 or 11; number of stigmata could not be determined exactly because all zooids examined were rather strongly contracted. Six large tentacles (?), dorsal languets distinct. Anus opening at level of seventh transverse vessel. Stomach situated approximately at middle of abdomen, elongated, with 5 longitudinal folds including typhlosole. Proximal end of rectum distinctly constricted from middle intestine and forms a pair of inconspicuous caeca (fig. 1*k*). No gonads seen in any postabdomens dissected.

REMARKS.—The lacunar system of the present colony seems to differ from that of the typical *Aplidium lobatum*, which consists of several radiating canals converging on a common cloacal aperture. The number of stigmatal rows, up to 11, seems to be too great for typical *A. lobatum*, though a form of this species, *A. tremulum* Savigny, is figured as having 11 rows also. The zooids are rather small as compared with those of typical forms. All these differences, however, seem to be insufficient to separate the present specimen from *A. lobatum* as a distinct form.

2. *Aplidium* sp. aff. *depressum* Sluiter

FIGURE 2

Aplidium depressum Sluiter, 1909, p. 102, pl. 5, fig. 6.—Van Name, 1918, p. 167, fig. 115.

MATERIAL EXAMINED

PHILIPPINE ISLANDS, Baliwasan: W. R. Taylor, sta. 10 (jar 2). One small colony, 5 mm. × 2 mm. in extent, attached to an alcyonarian coral (USNM 11660).

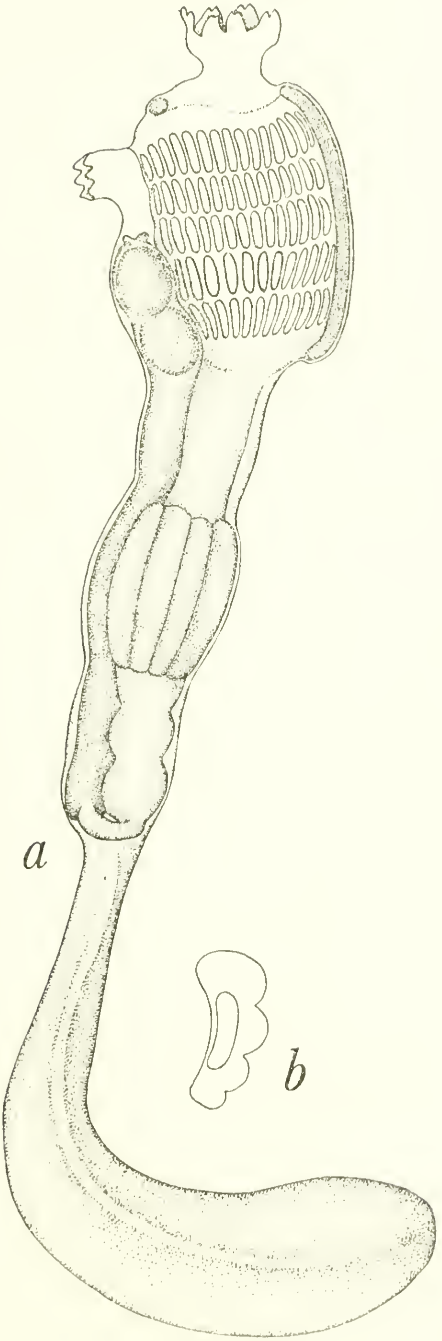

Figure 2.—*Aplidium* sp. aff. *depressum* Sluiter: *a*, right side of a zooid, *b*, section of the stomach.

Description.—Surface densely covered with sand grains. Test soft, gelatinous, but impregnated with sand grains in layers of abdomen and postabdomen; however thoracic layer quite free from sand grains. Only 3 zooids comprise this small colony. Abdomen about 1.5 times the length of contracted thorax. Length about 2.5 mm. when both thorax and abdomen are measured together. Postabdomen nearly as long as abdomen. Both branchial and atrial apertures 6-lobed; lobes of branchial aperture bifid, especially dorsal and ventral lobes. Atrial aperture opening at tip of short siphon which arises at level of first stigmatal row; atrial languet absent. About 15 longitudinal muscles on each side of the thorax. Five stigmatal rows, each containing 12–15 stigmata. Anus situated at level of third transverse vessel. Stomach located near middle of abdomen, longer than wide, with 4 longitudinal plications on free surface. Proximal end of rectum distinctly constricted from foregoing part of alimentary canal, but caeca are formed only inconspicuously. Mature gonads not found in zooids examined.

Remarks.—Typical *A. depressum* has 6 or 7 (according to Van Name, 1918), or up to 9 (according to Sluiter, 1909) rows of stigmata on the branchial sac and about a dozen (Van Name, 1918) to "zahlreiche" (Sluiter, 1909) longitudinal plications on the surface of the stomach. In the present specimen, there are 5 stigmatal rows and only 4 plications on the stomach. The difference in the number of stigmatal rows may be insignificant, but the number of longitudinal plications on the stomach is so remarkable that I hesitate to identify the specimen as *depressum*. It is possible that the specimen belongs to another distinct species, yet it is not impossible that the specimen represents a very young stage of *depressum* and the longitudinal plications on the stomach may increase with the growth of the zooids or with the growth of the colony. On the other hand, the appearance of the atrial aperture, which is 6-lobed and devoid of atrial languet, resembles exactly that of the Philippine specimens described by Van Name (1918). For these reasons I prefer to treat the specimen as a form near *Aplidium depressum*.

3. *Aplidium spitzbergense* Hartmeyer

Figure 3

Aplidium spitzbergense Hartmeyer, 1903, p. 341, pl. 6, fig. 14; pl. 13, fig. 17.
Amaroucium spitzbergense Van Name, 1945, p. 30.

MATERIAL EXAMINED

Bering Sea: *Albatross* sta. 3315. Two massive colonies; one is 11 mm. × 28 mm. in extent and 19 mm. in height, the other is only 4 mm. × 12 mm. in extent (USNM 11734).

Description.—The larger colony contains zooids preserved perfectly, although part of the colony is much mutilated, while the

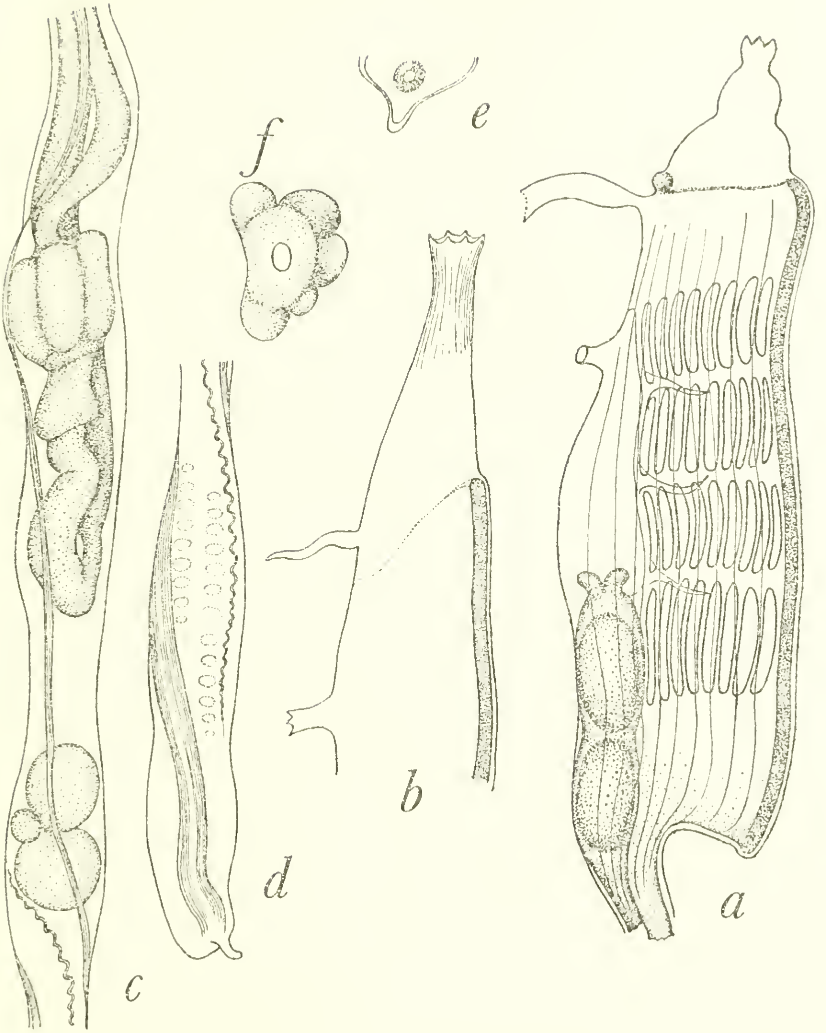

FIGURE 3.—*Aplidium spitzbergense* Hartmeyer: *a*, right side of thorax; *b*, situation of atrial languet anterior to dorsal ganglion; *c*, abdomen and proximal half of the postabdomen; *d*, distal half of postabdomen; *e*, ciliated groove; *f*, frontal view of stomach.

smaller one includes only a small number of damaged zooids. Both colonies are encrusted heavily with fine, black sand grains.

Test soft and gelatinous, containing a large number of fine, black sand grains. System of zooid arrangement is not discernible at surface. Zooid length averages about 4 mm. in a contracted state, excluding postabdomen. Thorax and abdomen neary equal in length. Postabdomen rather short in some zooids, but reaching 1.5 times the length of abdomen in others. In extended state zooids would be much longer than measurements given above, because some extended thoraces found in the colony reach 4 mm. in length. Branchial aperture 6-lobed. Atrial aperture round or 6-lobed, opening at tip of short siphon projecting at level of first stigmatal row. Atrial languet distinct, far anterior to atrial siphon; location somewhat variable—just behind dorsal ganglion in some zooids, slightly anterior to ganglion in others (fig. 3*b*). Nine fine, longitudinal muscles on each side of thorax. Stigmatal rows 4, about 8 stigmata in each row. A wide space between peripharyngeal band and first stigmatal row, also between fourth stigmatal row and posterior end of branchial sac. Tentacles about 10; ciliated groove an oval opening; dorsal languets very distinct and slightly displaced to left of dorsomedian line. Anus bilobed and situated at level of third transverse vessel. Stomach situated at middle of abdomen, with 5 longitudinal plications when the narrow typhlosole and four wider ordinary plications are counted together. Proximal end of rectum constricted from foregoing part of alimentary canal; but no caeca are formed there. Ova found near middle of range between the posterior end of intestinal loop and frontal end of testis. Testis not fully matured, follicles arranged in two rows?

REMARKS.—Fewer stigmatal rows and the situation of the atrial languet widely apart from the atrial siphon are the characteristics of the present species. *Amaroucium distomoides* Herdman, 1899, from Port Jackson, Australia, closely resembles the present species in that its zooids have 3 or 4 stigmatal rows. However, the test of the Australian species is free from sand grains. Although in many forms this feature cannot be regarded as a significant characteristic to separate species, the localities of the two species are so far apart from each other that the conspecificity of these species is quite impossible.

4. *Aplidium yezoense*, new species

FIGURE 4

HOLOTYPE.—USNM 11802, Japan: Hokkaido Island, Hakodate; E. S. Morse, collector.

PARATYPES.—USNM 11803, same data.

DESCRIPTION.—Seven colonies are in the material, the largest, measuring 30 mm. × 28 mm. in extent, is the holotype. They consist of a number of cormidia and are attached to gravel below. Larger cormidia roughly finger-shaped and may attain 11 mm. in length and 5 mm. in diameter.

Test cartilaginous, pale grayish brown, and slightly translucent so that the reddish brown zooids can be seen faintly through it. Surface smooth and quite free from foreign matter. Common cloacal aperture at center of distal end of each cormidium, being surrounded by

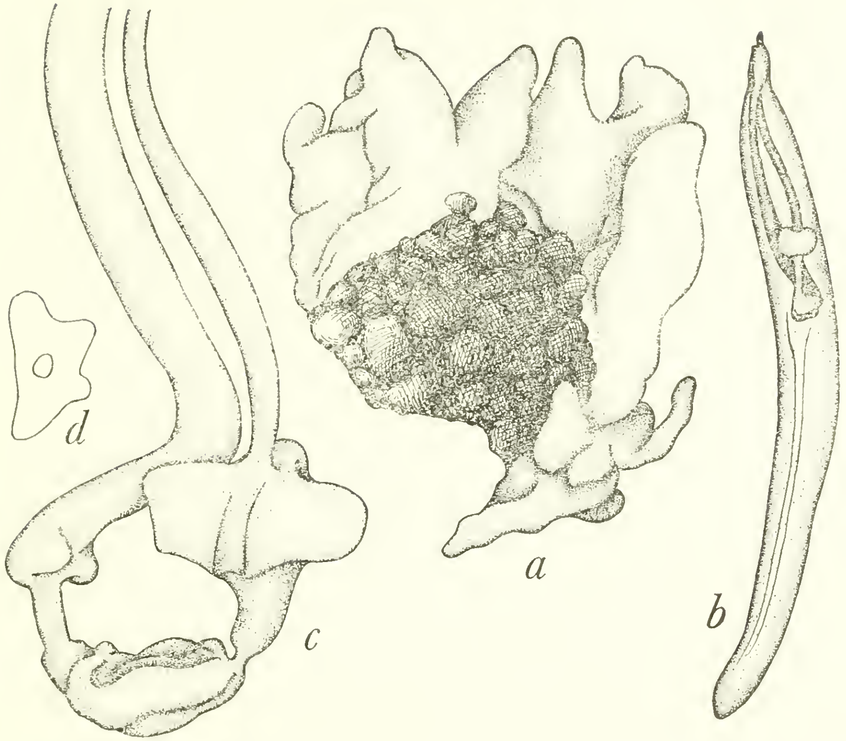

FIGURE 4.—*Aplidium yezoense*, new species: *a*, one of the colonies; *b*, zooid with minute thorax; *c*, intestinal loop; *d*, section of stomach.

several zooids. Distal portion of cormidium where thoraces of zooids are embedded somewhat soft in consistency as compared with basal half. Zooids may reach about 9 mm. in length. Thorax missing in most zooids or very small when it exists. Colonies probably in resting stage when all old thoraces are torn down and new ones are in process of regeneration. Eight stigmatal rows? Both abdomen and postabdomen filled compactly with mesenchyme cells; postabdomen much longer than abdomen. Intestinal loop may reach 4 mm. in length. Stomach considerably wider than long with 4 longitudinal plications on surface, situated at level of posterior one-third of length of intestinal loop. Hind stomach distinct; middle intestine occupies posterior end of intestinal loop and is marked with a few irregular longitudinal folds. Proximal portion of rectum swollen distinctly at level of posterior margin of stomach forming a pair of roundish caeca. Gonads not found in zooids examined.

REMARKS.—In *Amaroucium fragile* Redikorzev, 1927, from the Okhotsk Sea, the colony consists of many cormidia, the zooids are provided with 10–11 stigmatal rows and the stomach with 4–5 longitudinal plications. These features somewhat resemble those of the present specimen. However, the esophagus is much longer in the present species than in Redikorzev's species, with the result that the stomach is located more posteriorly, and it is evidently wider than long compared with the elongated stomach of *A. fragile.* The colony of *A. fragile* is encrusted with sand grains over the surface. These differences seem to be too remarkable to be regarded as the result of the contraction of specimens or as temporal features due to special ecological or physiological conditions. Thus the present specimens are here treated as a distinct species and named after the locality.

5. *Amaroucium constellatum* Verrill

Amouroucium constellatum Verrill, 1871b, p. 359.
Amaroucium constellatum Van Name, 1945, p. 38, fig. 8; pl. 8, fig. 1.—Tokioka, 1951a, p. 2, pl. 1, figs. 2–4.

MATERIAL EXAMINED

JAPAN: Hokkaido Island, Hakodate, E. S. Morse, collector. One colony 23 mm.×17 mm. in extent and about 10 mm. in thickness, attached to coarse sand grains and pebbles (USNM 11694).

DESCRIPTION.—Test gelatinous, rather hard to the touch; surface irregularly elevated and depressed, but quite free from foreign inclusions. The basal part covered with many small algae. The system of zooid arrangement obscure, probably because of strong contraction. Stigmatal rows 13, with about 13 stigmata in each row. Dorsal languets displaced to left side from dorsomedian line for the distance of three stigmata. About 25 longitudinal plications on stomach.

6. *Amaroucium glabrum* Verrill

FIGURES 5; 12*b,e,f*

Amouroucium glabrum Verrill, 1871a, p. 288, figs. 20–22.
Amaroucium glabrum Van Name, 1945, p. 31, fig. 4; pl. 1, fig. 5.—Tokioka, 1951a, p. 1, pl. 1, fig. 1.

MATERIAL EXAMINED

SAKHALIN (KARAFUTO) ISLAND: In Okhotsk Sea, off Cape Patience; *Albatross* sta. 5025. One colony, an ovoid mass, 10 mm.×6.5 mm. in extent (USNM 11741).

JAPAN: West coast of Hokkaido somewhat north of Otaru; *Albatross* sta. 4993. One roughly cylindrical colony 12 mm. long and 5 mm. in diameter, attached to a large tuft of dead hydrozoan colonies, together with sponges (USNM 11778).—Otaru, west coast of Hokkaido; E. S. Morse, collector. Seven colonies attached below to coarse sand grains; largest colony 30 mm.×16 mm. in extent, maximum thickness 3 mm.; probably the colonies were thicker than 3 mm. when alive and fully extended (USNM 11691).—Tsugaru Strait, off Cape Tsiuka: *Albatross* sta. 4808. Two encrusted colonies, the larger one 13 mm.×8.5 mm. in extent and 1.5 mm. in thickness; the smaller 11 mm.×4 mm. (USNM 11632).

DESCRIPTION.—Test gelatinous, translucent, yellowish white. Surface smooth and quite free from any foreign matter in specimens from Otaru (11691), but in others it is mostly encrusted in various degrees

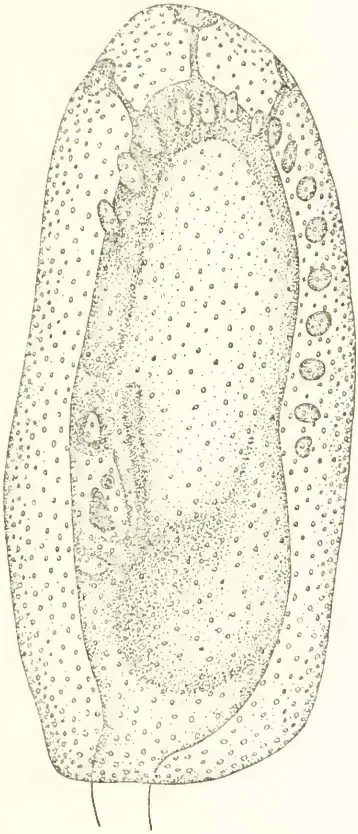

FIGURE 5.—*Amaroucium glabrum* Verrill: larva, right side of trunk.

with sand grains, with which the test is also impregnated, as seen in the colony from *Albatross* sta. 4993 (11778), which consists of the exposed, whitish, and nearly opaque corona and the basal peduncular portion covered with sand grains (fig. 12*b*). System of zooid arrangement obscure. Zooids situated obliquely (?), all contracted rather strongly, being 2–3.3 mm. in length. Zooids reddish brown and faintly visible through test in some colonies. Abdomen half as long as thorax or nearly equal to the latter in a strongly contracted state. Postabdomen varies considerably in length; most frequently as long as thorax and abdomen measured together in a contracted state, reaching 11–12 mm. in some zooids. Branchial aperture 6-lobed, atrial languet with simple tip. Longitudinal muscles 8–15 on each side of thorax; some dorsal muscles rather fine. Stigmatal rows 8–11; anus opens at level of sixth or seventh transverse vessel. Ciliated groove a small oval opening. Stomach situated near middle of abdomen; with 10–15 longitudinal plications on surface, excluding typhlosolis. Proximal portion of rectum swollen conspicuously, possibly forming a pair of caeca when animal is alive and fully extended. Postabdomen considerably long, filled with yellowish-orange mesenchyme cells in most zooids, except for those colonies from Otaru. In these, 23 testicular follicles arranged roughly in two rows in an examined zooid.

Trunk of larvae elongated, 550μ long or 620μ×340μ in specimens examined. Three disc-shaped attachment processes arranged lineally. Sixteen pairs of small ampullae in anterior half of trunk. Sensory organ situated at level of posterior one-third, two pigment flecks arranged anteroposteriorly. Larval test granulated.

REMARKS.—Colonies encrusted and impregnated with sand grains closely resemble *A. constrictum* Sluiter from tropical waters, as stated later.

7. *Amaroucium pliciferum* Redikorzev

FIGURE 6

Amaroucium pliciferum Redikorzev, 1927, p. 387, figs. 9–10.—Tokioka, 1953a, p. 183, pl. 6, figs. 1–10; pl. 7, fig. 1.

MATERIAL EXAMINED

HAWAIIAN ISLANDS: Auau Channel between Maui and Lanai; *Albatross* sta. 3875. One colony surrounding branch of coralline algae (USNM 11735).

DESCRIPTION.—Colony roughly cylindrical in form, 30 mm. in length, 13–14 mm. in diameter. Test gelatinous, rather hard, milky white and opaque. Surface marked with many irregularly arranged grooves, but quite free of any foreign matter. Several common cloacal apertures opening at the bottom of grooves, zooids also open in the grooves. External appearance clearly shows that colony is strongly contracted. Atrial languet projecting from middle of area between dorsal ganglion and atrial aperture (fig. 6*b*); tip of languet simple or bifid. Stigmatal rows 13–15, with about a dozen stigmata in each row. Ciliated groove a small, oval opening. Stomach slightly anterior to middle of abdomen, about two-thirds as long as contracted thorax; longitudinal plications on surface 18–23, including typhlosolis. One pair of caeca at proximal end of rectum. Postabdomen rather thin and very long, being 1.5 to 3 times the length of thorax and abdomen, or even longer in some zooids. Testicular follicles numerous, usually 50–60, arranged roughly in two rows; they may be flattened anteroposteriorly, as shown in figure 6*c*, when packed compactly in

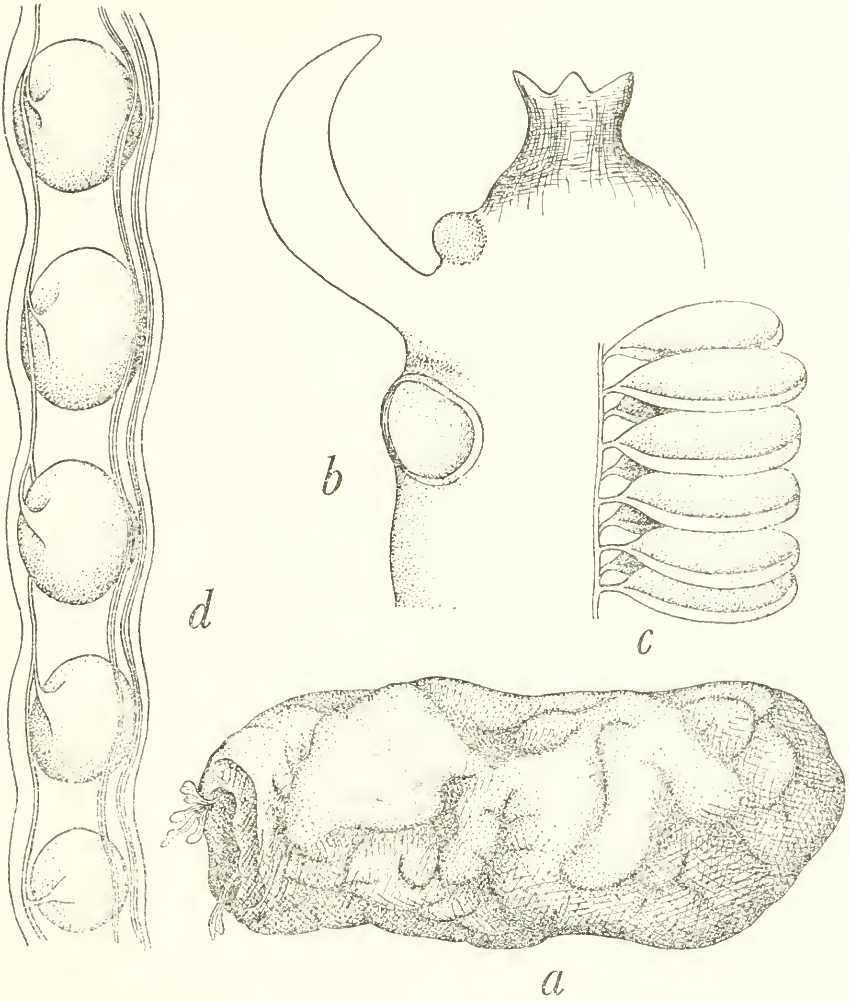

Figure 6.—*Amaroucium pliciferum* Redikorzev: *a*, entire colony; *b*, anterior part of zooid, right side; *c*, flattened testicular follicles packed compactly in postabdomen of usual thickness; *d*, spherical testicular follicles arranged in a single row in the thinner postabdomen.

postabdomen of usual thickness, or spherical and arranged in a single row when they occupy thinner postabdomens (fig. 6*d*).

8. *Amaroucium* sp. aff. *monotonicum* Tokioka

Figure 7

Amaroucium monotonicum Tokioka, 1954a, p. 4, pl. 19, figs. 4–5; pl. 20, fig. 1.

MATERIAL EXAMINED

Palau Islands: Ngerkuid, west of Eil Malk; GVF sta. 261. Six small colonies, attached to a tuft of *Halimeda* (USNM 11393), along with colonies of *Didemnum ternatanum* (Gottschaldt) (USNM 11398).

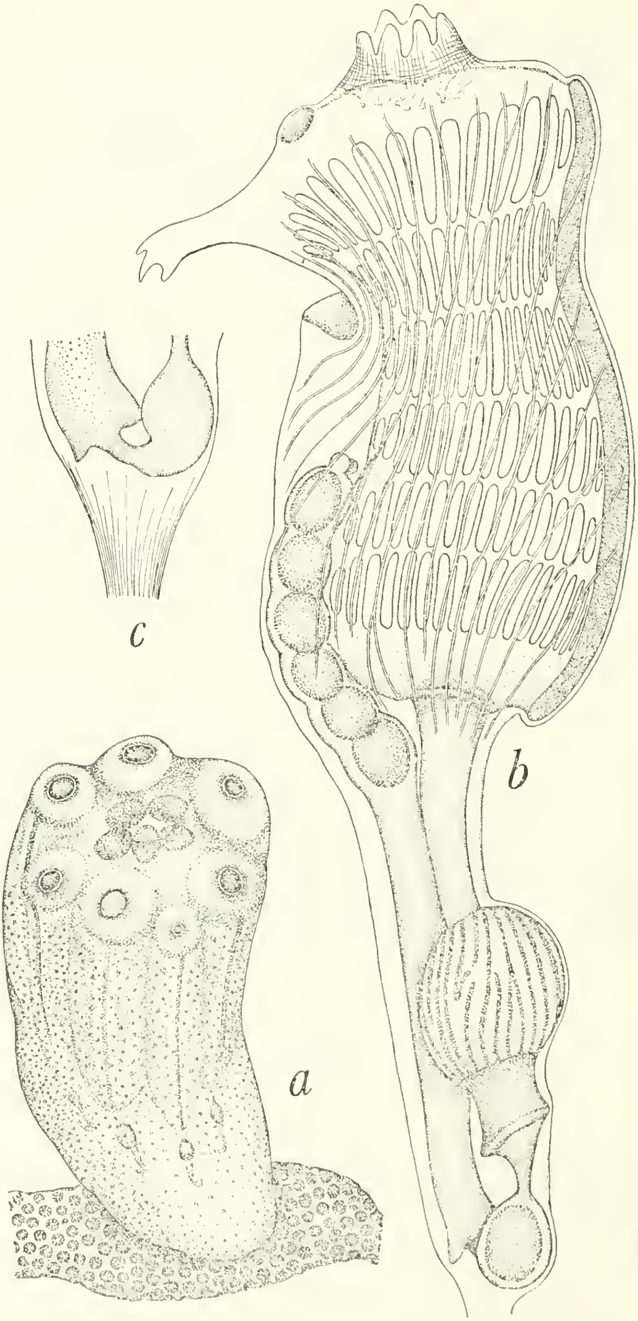

Figure 7.—*Amaroucium* sp. aff. *monotonicum* Tokioka: *a*, entire colony; *b*, right side of zooid, excluding postabdomen; *c*, posterior portion of intestinal loop, showing a pair of caeca at proximal end of rectum.

DESCRIPTION.—Four of the six colonies are represented by a single cormidium each, while each of the other two consists of two cormidia attached to each other side by side at their basal portions. Largest cormidium 3.5 mm. in diameter and 4 mm. in length. Distal half of each cormidium occupied by thoraces of zooids; upper half of the rest of the colony contains abdomens. From 5 to 12 (average about 8) zooids, usually yellowish in color, arranged around a central, plainly margined common cloacal aperture, with their darkly colored endostyles toward the periphery of the colony. Several whitish fecal pellets found in cloacal lacuna just under common aperture. A parasitic copepod was found in the basal portion of one of the colonies.

Test gelatinous, translucent, densely sprinkled with many minute grayish-violet pigment spots. Surface quite free of foreign material. Zooids up to 4 mm. in length, embedded perpendicularly in test. Thorax and abdomen nearly equal in length, postabdomen short, less than two-thirds of abdomen. No constriction between abdomen and postabdomen. Branchial aperture 6-lobed, atrial languet rather short and trifid, darkly pigmented at tip. About 15 longitudinal muscles on each side of thorax, several ventral muscles running rather obliquely. Stigmatal rows 6, 15–18 stigmata in each row. No papillae along transverse vessels. Tentacles about 6. Ciliated groove a small oval opening. Dorsal languets roughly triangular and slightly displaced to left side of dorsomedian line. Peripharyngeal band heavily pigmented. Anus bilobed, opening at level of fourth transverse vessel. Stomach roughly globular in shape and situated near middle of abdomen, with about 30 longitudinal plications on its surface. Distinct caeca formed at proximal end of rectum. No gonads found in postabdomen of zooids examined.

REMARKS.—The present specimens very closely resemble *A. monotonicum* Tokioka from the Tokara Islands near Okinawa, but differ in the coloration of the colony (grayish violet instead of reddish orange in the latter), the number of longitudinal plications on the stomach surface (nearly twice the number in typical *A. monotonicum*) and in the appearance of the proximal end of the rectum (caeca are indistinct in the latter). It is very difficult to judge whether or not these differences should be regarded as significant characteristics differentiating the present specimens from the typical *A. monotonicum*. Thus, at present, the specimens are described here provisionally as a form near *A. monotonicum*.

9. *Amaroucium multiplicatum* (Sluiter)

FIGURES 8, 9

Aplidium multiplicatum Sluiter, 1909, p. 101, pl. 5, fig. 5.
Amaroucium multiplicatum Van Name, 1918, p. 165, fig. 113; pl. 31, fig. 26.
Amaroucium sp. aff. *multiplicatum* Tokioka, 1953a, p. 181, pl. 10, figs. 1–4.
?*Amaroucium californicum* Ritter and Forsyth, 1917, p. 483, pl. 46, fig. 72.

non *Amaroucium multiplicatum* Tokioka, 1953a, p. 180, pl. 5, figs. 1–4. (= *Amaroucium sagamiense* Tokioka, new species. See below, p. 40.)

MATERIAL EXAMINED

Palau Islands: Urukthapel Is., reef south of Ngaremdiu; GVF sta. 227, one colony (USNM 11446).—Eil Malk, fringing reef of small island in lagoon; GVF sta. 252, four colonies (USNM 11428).—Ngerkuid, west of Eil Malk; GVF sta. 261, six colonies (USNM 11394).

Gilbert Islands: Onotoa Atoll; A. H. Banner, sta. B–3, 11 colonies (USNM 11485); sta. B–4, 3 colonies (USNM 11495) and 1 colony (USNM 11496).

Description.—The largest of 15 specimens from Onotoa Atoll is 16 mm. × 12 mm. in extent; their thickness varies from 2 to 9 mm. Of the 11 colonies from the Palau Islands, the larger range from 23 mm. × 10 mm. to 17 mm. × 14 mm. in extent, and from 4 to 9 mm. in thickness; 6 of them are attached to pieces of *Halimeda.* The small colonies roughly massive, the larger ones sometimes rather encrusted like some forms of Didemnidae and Botryllidae. Surface smooth and free of foreign matter and glistens in some small colonies from Palau Islands. The system of arrangement of the zooids is roughly stellate in smaller colonies and usually consists of 8–9 zooids surrounding one central common cloacal aperture, although it is not so regularly formed. In larger colonies, however, the system is rather indistinct and resembles that usually found in common species of the genus of *Botrylloides.* In such colonies two or more common cloacal apertures are on the surface. The apertures vary in size, some large ones attaining 6 mm. in long diameter; the margin of the apertures may be smooth in some specimens, although it is fringed with some small prominences in others.

Test soft, gelatinous, translucent and milky white, pale yellowish to reddish brown or dark purplish, densely sprinkled with purplish black pigment. No sand grains found in test. Whitish fecal pellets in lacunar system seen through test. Zooids faintly colored in pale brown, reddish brown, or sprinkled with purplish-black pigment in various degrees. Thorax heavily pigmented in some zooids, abdomen usually pigmented very lightly. Both dorsal and ventral sides of esophagus, cardiac portion of stomach, and proximal portion of rectum rather darkly pigmented in some zooids. Zooids usually 4.5 to 6 mm. in length, although only 1.5 mm. in length in a strongly contracted state; extended thoraces may reach 3 mm. in length. Zooids usually situated perpendicularly in thicker colonies, but somewhat obliquely in thinner colonies. Abdomen one-fourth to one-third the length of thorax in a contracted state, but nearly equal to or longer than thorax in some wholly extended zooids, even attaining 1.5 times the length of thorax. Postabdomen usually equal to or slightly longer than abdomen, although in immature stages containing no gonads it is much shorter (about one-third of the abdomen). In many colonies the postabdomen is placed obliquely or horizontally. Thus, in

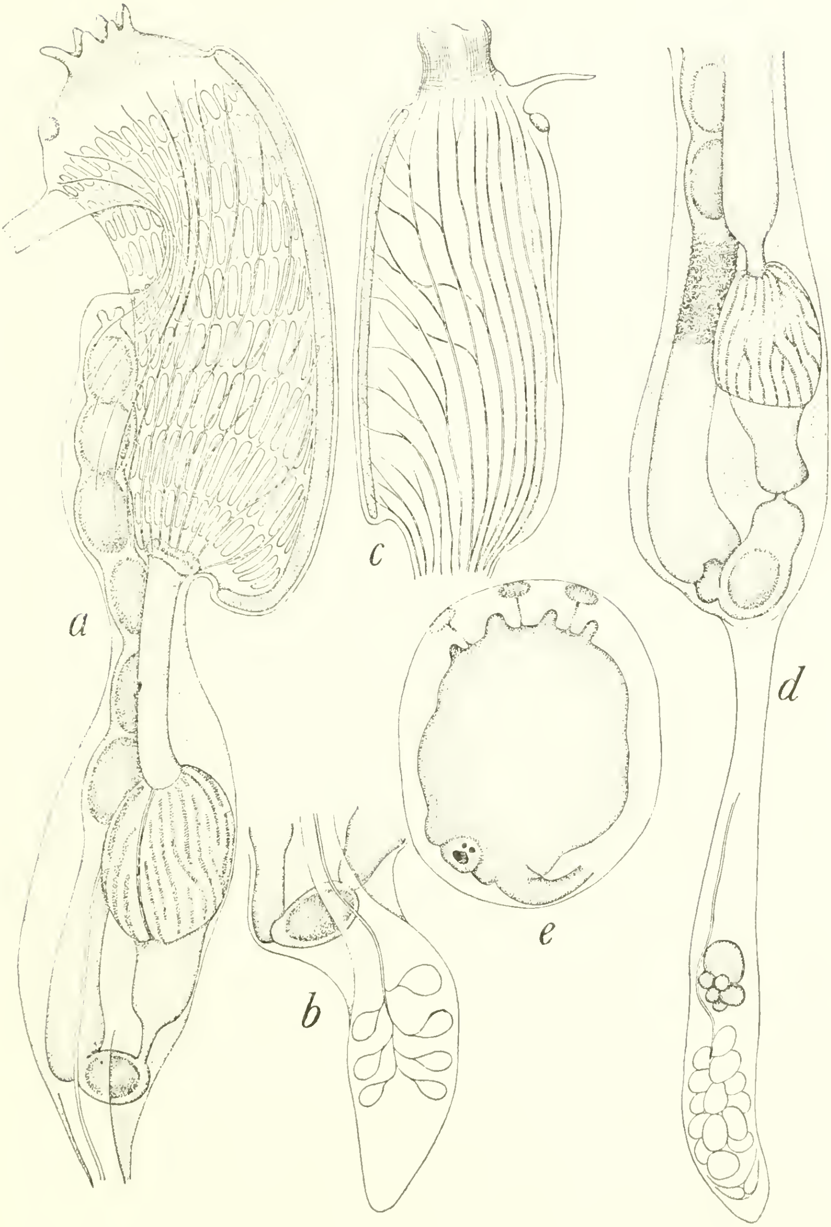

Figure 8.—*Amaroucium multiplicatum* (Sluiter): *a*, right side of zooid of colony from the Palau Islands; *b*, postabdomen of same zooid; *c*, left side of thorax of zooid of the 15 mm. × 12 mm. colony from the Palau Islands; *d*, right side of abdomen and postabdomen of the 11 mm. × 9 mm. colony from the Gilbert Islands; *e*, right side of very young embryo from the Gilbert Islands.

some zooids of a colony from the Palau Islands, postabdomen issues from left posterior side of intestinal loop (fig. 8*b*) just at level of junction between hind stomach and middle intestine, instead of extending from rear end of loop.

Branchial aperture 6-lobed; each lobe may be subdivided into 3 lobules in some specimens. Atrial aperature opening at rather a higher level, varying from first transverse vessel to fourth stigmatal row; roundish or oval in outline. Atrial languet usually short, even indistinct in some specimens, tip usually simple or rarely trifid; situation of languet varies from posterior side of dorsal ganglion to anterior side of atrial aperture. About 15 longitudinal muscles on each side of thorax, several ventral ones of which are running obliquely or partially transversely. Stigmatal rows 7 to 10; number of stigmata in each row fewer in smaller zooids of the colonies from the Gilbert Islands, only about 10; may number up to 30 in larger zooids of colonies from the Palau Islands. In the latter case, about 6 stigmata near each end of respective rows diminish in size toward endostyle or dorsomedian line. Stigmata fringed with yellowish corpuscles in some specimens. Transverse vessels heavily pigmented in some zooids; horizontal membranes well developed, but without papillae. Some larger zooids of the 15 mm. × 12 mm. colony from the Palau Islands are provided with some fine transverse vessels, just like parastigmatic vessels, partially on the outer side of the stigmatal row. Tentacles 8 to 12, larger and smaller ones alternating regularly; situated anteriorly far apart from the peripharyngeal band and somewhat triangular in shape in some zooids examined. Ciliated groove a small oval opening; dorsal languets finger-shaped and displaced from the dorsomedian line to the left side for the distance of 2 to 5 stigmata. Anus opening at level of

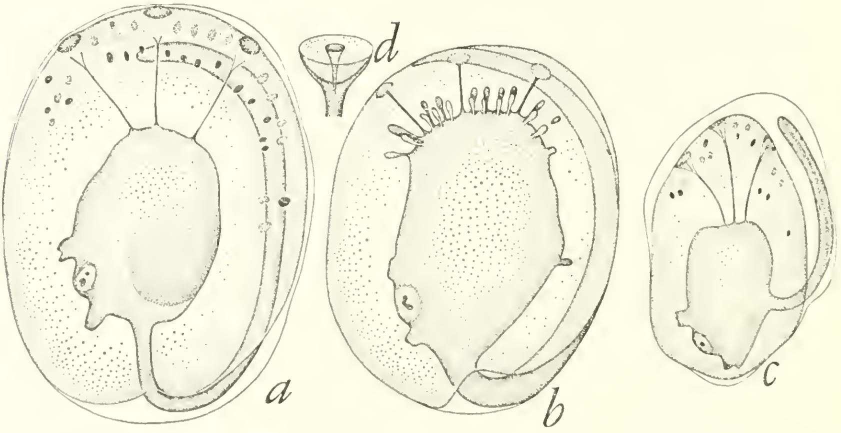

FIGURE 9.—*Amaroucium multiplicatum* (Sluiter): *a*, right side of fully developed embryo from same colony as that of figure 8*e*; *b*, right side of slightly younger embryo from same colony; *c*, right side of embryo from the Palau Islands; *d*, one of the attachment discs.

fourth or fifth transverse vessel. Fertilized eggs 3 to 7, or embryos in various stages of development found in incubatory pouches of zooids examined. Stomach situated near the middle of abdomen, with 20–35 longitudinal plications on the surface, some somewhat irregularly arranged. Esophagus rather thick, may be slightly swollen near posterior end just before it enters cardiac end of stomach in some zooids of colonies from the Gilbert Islands. Proximal end of rectum swollen considerably and distinctly constricted from midintestinal portion occupying posterior end of intestinal loop, but no distinct caecum is formed there. Circumintestinal gland a whitish glandular tissue on the rectum, extending upward from the level of middle of stomach for the distance of the stomach length. Ovary situated above testis; testicular follicles attain 45 in larger postabdomens, but may be fewer than 8 in smaller ones.

Embryos rather large, up to 1100 μ in length. Attachment processes 3, cup-shaped, roundish in outline, and arranged lineally; stalks long and slender, in a fully developed stage their distal ends may fail to reach the attachment discs (fig. 9*a*). Four pairs of ampullae are seen in an earlier stage (fig. 8*e*), increasing in number (fig. 9*b*) with development until liberated from the body surface of the embryonal trunk as many small bulbs scattered in the anterior portion of the embryonal test. In 3 embryos examined these bulbs are arranged as follows:

			1	2	3	2			
(1) 19 ampullae in total.	Dorsal	1					1	1	Ventral
			1	2	3	2			
(2) Younger stage (fig. 9*b*), 22 ampullae in total.			1	2	4	2			
	Dorsal	1					1	1	Ventral
			1	3	4	2			
(3) Older stage (fig. 9*a*), 33 ampullae in total.			3	4	4	3			
	Dorsal	1					1	3	Ventral
			2	3	4	5			

Sensory organs situated in posterior part of the trunk; pigment flecks arranged anteroposteriorly or somewhat obliquely in advanced stages. Tail held on the left side of trunk.

Remarks.—The present specimens conform well to both the original form from the *Siboga* collection and that described by Van Name from Philippine waters. The longitudinal plications on the stomach are rather numerous in some of the present specimens and thus the range of variation is extended to 18–35. *Amaroucium* sp. aff. *multiplicatum* described by Tokioka (1953a) from Sagami Bay, Japan, is evidently identical with *multiplicatum* itself; the longitudinal plications on the stomach are numerous enough and no distinct caecum is formed at the proximal end of rectum. The structure of the larva in that form is essentially the same as found in larvae in the present specimens; the figure of the larva given by Tokioka (1953a, pl. 10, fig. 4) is evidently strongly deformed, but it seems to correspond to the stage shown in figure 9*b* in the present paper. On the other hand, *A. multiplicatum* described by Tokioka (1953a, p. 180) from Sagami Bay seems to differ clearly from the group comprising the above-mentioned forms in the following points: (1) fewer (up to 14) longitudinal plications on the stomach; (2) existence of a pair of distinct caeca at the proximal end of the rectum; and (3) smaller (up to 530μ) embryos with a number of small vesicular bodies in the anterior part and fewer of them in the posterior portion of the trunk. As none of these gaps are filled by any of the comparatively numerous present specimens, it seems more reasonable to distinguish Tokioka's specimens from Sagami Bay as a distinct new form rather than to treat them together with the group comprising the present specimens under *A. multiplicatum*. A new name, *Amaroucium sagamiense*, is here proposed for that form.

A. californicum Ritter and Forsyth closely resembles *A. multiplicatum;* it is highly possible that these two species are quite identical, though I hesitate at present to treat them together, because their localities are so far apart.

10. *Amaroucium crateriferum* Sluiter

FIGURES 10, 11

Amaroucium crateriferum Sluiter, 1909, p. 103, pl. 5, fig. 7; pl. 8, fig. 11.—Van Name, 1918, p. 163, fig. 112; pl. 33, figs. 45–46.

MATERIAL EXAMINED

PALAU ISLANDS: Iwayama Bay, east side of Oyster Pass; GVF sta. 220. Two colonies (USNM 11410).—Iwayama Bay, entrance of Oyster Pass; GVF sta. 236A. One colony (USNM 11424).

DESCRIPTION.—One of the specimens examined is 43 mm.×40 mm. in extent and 25 mm. in height; the second is 65 mm.×45 mm. in extent and 8 mm. in thickness; and the last one is somewhat conical in shape, 60 mm.×40 mm. in extent and 55 mm. in height. They are massive, yellowish or grayish brown, and attached to the substratum by the lower surface. Surface is smooth but marked by irregular grooves. System of arrangement of the zooids is indistinct.

Zooids orange, orange-red, or reddish brown, open at bottom of grooves, arranged so as to converge on point of attachment. Zooids long, reaching a maximum of 18 mm. in those examined, very probably reaching 20 mm. in length when alive. Postabdomen very long, occupying nearly two-thirds of body length; or may be 3 to 4 times as long as thorax and abdomen measured together. Abdomen nearly as long as contracted thorax. Branchial aperture 6-lobed; atrial aperture situated near dorsoanterior corner of thorax, sometimes opening

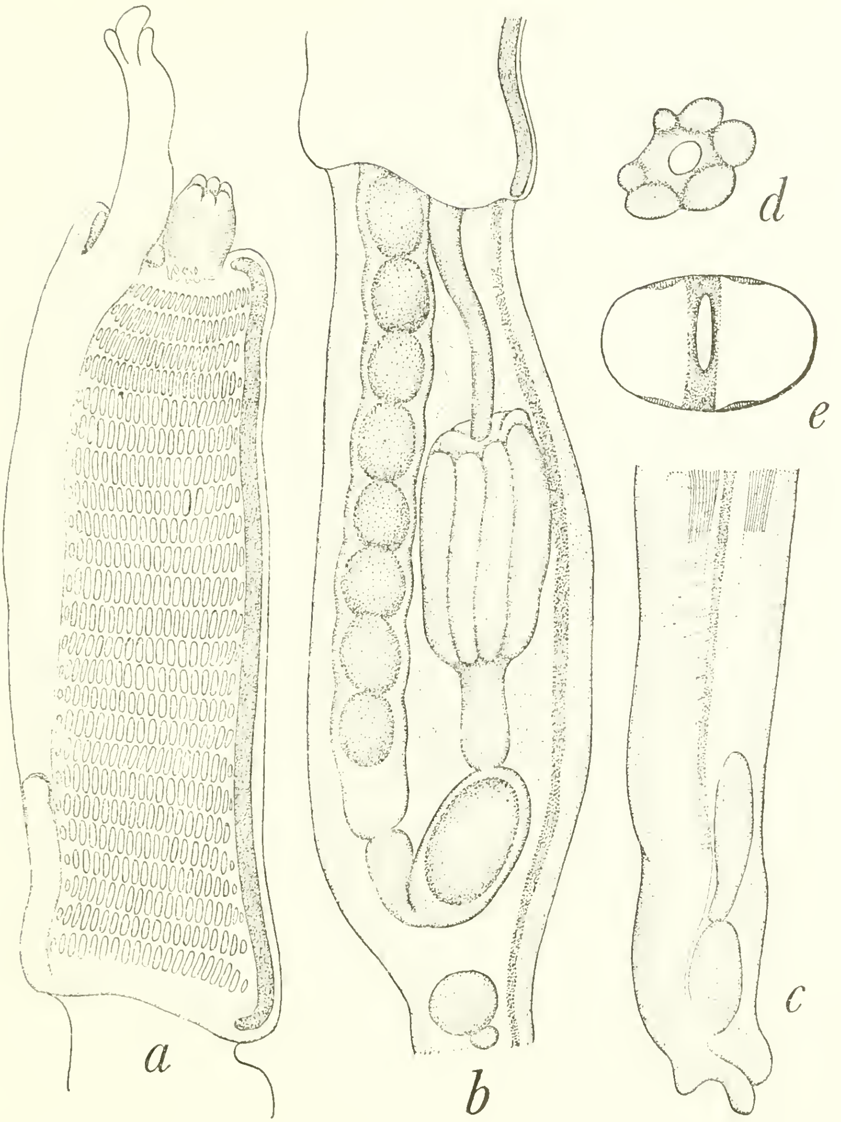

Figure 10.—*Amaroucium crateriferum* Sluiter: *a*, right side of thorax; *b*, right side of abdomen of same zooid; *c*, right side of posterior part of postabdomen of same zooid; *d*, frontal side of stomach; *e*, transverse section of postabdomen.

at the end of a short siphon and with a long atrial languet ending in a trifid tip. About 25 longitudinal and about 20 transverse muscles on each side of the thorax. From 20 to 24 stigmatal rows, up to 20 stigmata in each row. Horizontal membranes well developed along transverse vessels. Six large tentacles, besides some smaller ones? Ciliated groove an oval opening. Dorsal languets of a moderate

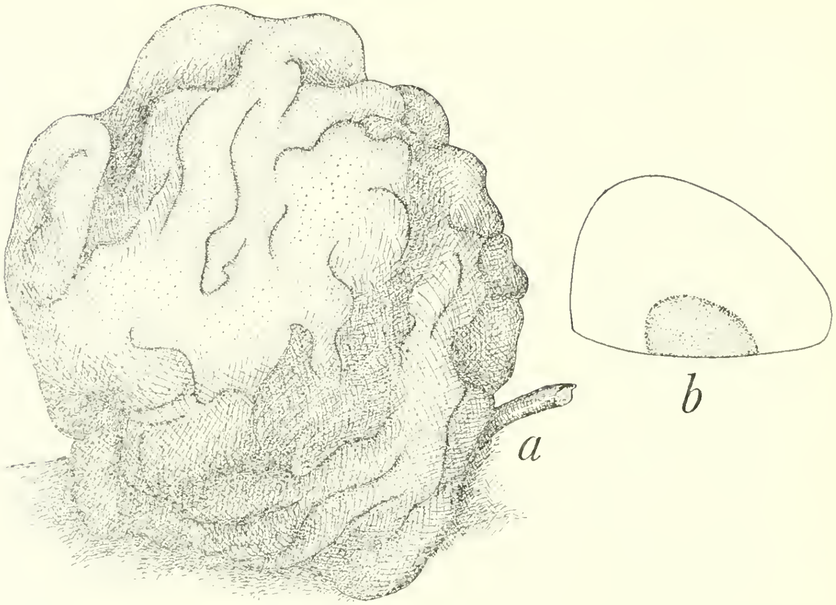

Figure 11.—*Amaroucium crateriferum* Sluiter: *a*, colony, 43 mm. × 40 mm. in extent; *b*, schema showing outline of the 60 mm. × 40 mm. colony (concave depression on underside is attachment surface to substratum).

size. Anus bilobed, with thickened lips, opening at level of fifth or sixth transverse vessel (numbered from the posterior end of the branchial sac). Stomach situated near middle of abdomen, with 6 longitudinal plications on its surface. Proximal portion of rectum distinctly constricted from midintestine, but no caecum formed there. Testicular follicles numerous and arranged in two rows (?).

Remarks.—Present specimens have a few more stigmatal rows and also more stigmata in each row than the type specimens from the *Siboga* collection (18 rows and 11–16 stigmata in each row) and the specimens from the Philippines (about 20 rows and 11–14 stigmata in each row). As figure 7*a* given by Sluiter evidently shows 21 stigmatal rows on the right side of the thorax, the numerical data in the original description might possibly have been taken from smaller zooids. On the other hand, there are considerably less longitudinal plications on the stomach surface in the present specimens than in the type specimens (12) and the Philippine specimens (about 10), although this difference cannot be regarded as a significant characteristic to separate the present specimens from *A. crateriferum.* The number of tentacles is small in the present specimens and in the Philippine specimens ("rather few"), though a considerably larger number in the type specimens from the *Siboga* collection (24).

11. *Amaroucium constrictum* Sluiter

FIGURES 12*a,c,d*

Amaroucium constrictum Sluiter, 1900, p. 17, pl. 1, fig. 8a.—Van Name, 1918, p. 167, fig. 114.

MATERIAL EXAMINED

PALAU ISLANDS: Iwayama Bay; GVF sta. 134. One colony 5 mm. in length (USNM 11461).

DESCRIPTION.—Colony small, encrusted, elongated; 5 mm. in length, very thin, containing only 9 zooids (fig. 12a). Test soft, gelatinous, transparent, impregnated with sand grains. No system is seen in arrangement of zooids. Zooids placed horizontally, pale pinkish. Thorax and abdomen of nearly same length, reaching 3 mm. when measured together. Branchial aperture 6-lobed; atrial aperture roundish and situated at level of second stigmatal row. Atrial languet clearly defined, with simple tip. About 10 longitudinal muscles on each side of thorax. Stigmatal rows 9; 3 rows present in range between anus and posterior end of branchial sac. About 10 stigmata in each row. Six large tentacles seen clearly, also some smaller ones? Ciliated groove an oval opening. Stomach situated near or slightly anterior to middle of abdomen, with posterior margin exactly at middle. From 7 to 9 longitudinal plications, excluding typhlosole, on surface of stomach. Middle intestine distinct; proximal portion of rectum swollen conspicuously, but no caecum is formed there in the contracted state. Postabdomen seems to be of considerable length. Proximal portion filled with mesenchyme cells. Vas deferens perfectly preserved, but neither testicular follicles nor ova were found in any zooids examined.

REMARKS.—This species resembles *Amaroucium multiplicatum* in the number of stigmatal rows, but differs in the number of longitudinal plications on the stomach and in the appearance of the test, test quite free from sand grains in the latter. From Japanese waters *A. sagamiense* is also related closely to the present species, especially in the number of longitudinal plications on the stomach, but it bears fewer (7) stigmatal rows and its test is quite free from sand grains. Most perplexing is the comparison between the present species and *A. glabrum* from northern cold waters. These species resemble each other so closely that the distinction between the two can be made usually only by the presence (*A. constrictum*) or the absence (*A. glabrum*) of sand grains in the test; but evidently this feature cannot be of absolute significance. The number of stigmatal rows (9 in the present specimens, 8 or 9 in both the Chatham and Philippine specimens) and that of longitudinal plications on the stomach (7–9 in the present specimens, 10 in the Chatham specimens and 10 to 12 in the Philippine specimens) are applicable to the zooids of *A. glabrum*. It seems rather

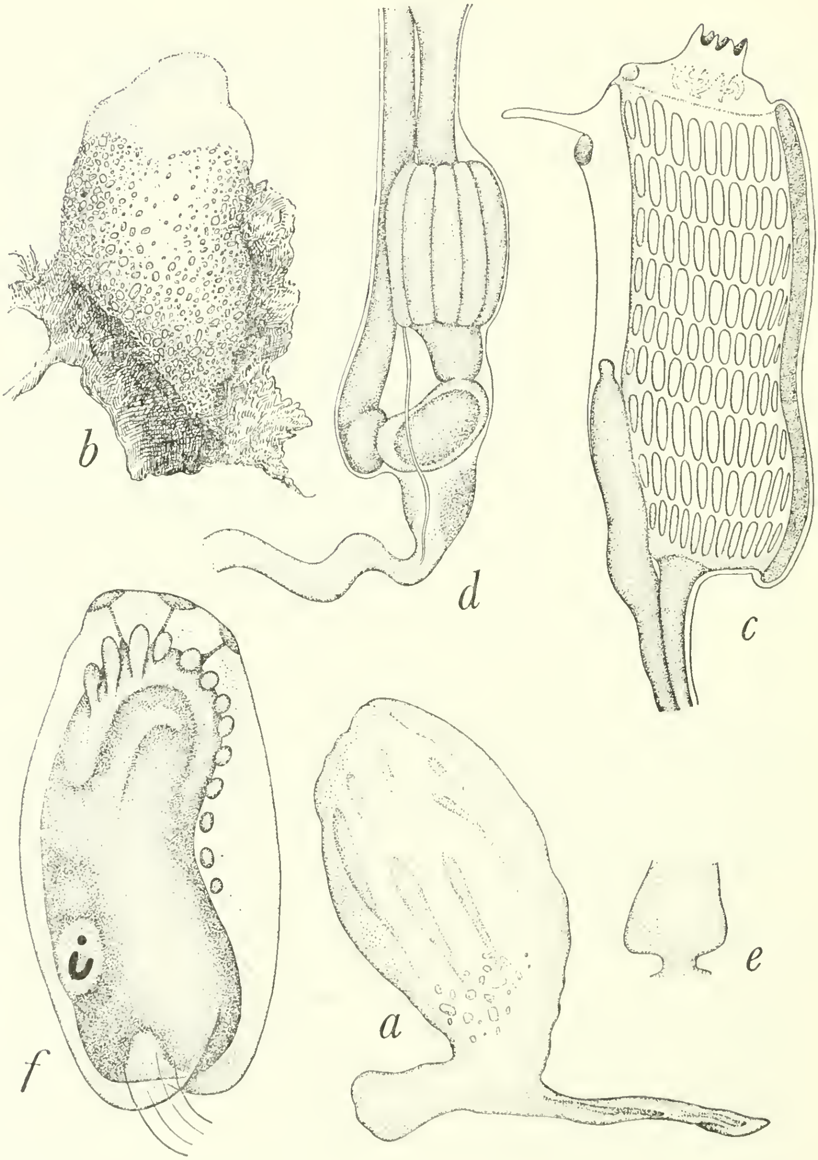

Figure 12.—*a*, *c*, *d*, *Amaroucium constrictum* Sluiter: *a*, entire colony; *c*, right side of thorax of a zooid; *d*, right side of abdomen of same zooid. *b*, *e*, *f*, *Amaroucium glabrum* Verrill: *b*, colony from *Albatross* sta. 4993, near Hokkaido Island, Japan; *e*, proximal portion of rectum in a zooid of the colony from Okhotsk Sea; *f*, right side of embryo from the colony from *Albatross* sta. 4993.

unlikely that the specimens from tropical waters are identical with *A. glabrum* from northern waters. Definite distinction between *A. constrictum* and *A. glabrum* might be made when larvae of the present species are found and compared carefully with those of *A. glabrum*. Until that time it would be hardly possible to distinguish small colonies of these two species from each other. The number of stigmata in each row in the present specimen conforms well to that of the type specimens (10) from the Chatham Islands, but is considerably smaller than that of the Philippine specimens (about 15) ; however, this difference seems to fall within the range of intraspecific variation.

12. *Aplidiopsis amoyense*, new species

FIGURE 13

?*Amaroucium variable* (sic) Chin, 1934, p. 489, pl. 53, fig. 5.

HOLOTYPE.—USNM 11529, China: probably vicinity of Amoy; T. Y. Chen (University of Amoy), sta. 8 (no further data); received October 12, 1932.

PARATYPE.—USNM 11530, same data; T. Y. Chen (University of Amoy), sta. 7 (no further data) ; received October 12, 1932.

DESCRIPTION.—The collection contains two colonies: holotype is somewhat mushroom-shaped (fig. 13*a*), the paratype is roughly spherical, with the underside narrowed into a short prominence by which the colony was attached to the substratum (figs. 13*d*,*e*). The holotype is 17 mm.×14 mm. in extent; corona 5–6 mm. in height and peduncular portion 18 mm. in length; the paratype is 18 mm. in diameter and 16 mm. in height.

Test gelatinous, soft but not fragile, translucent, yellowish white to grayish brown, containing a small number of fecal pellets. Surface of colony sparsely covered with mud and surface of peduncular portion slightly wrinkled. System of zooid arrangement observable on paratype specimen, which is evidently half of a spherical colony. Two systems found on surface of this specimen (fig. 13*d*), large and much smaller ones. Several radial canals issue from central common cloacal aperture and zooids are arranged on both sides of respective canals roughly in two or three rows. Zooids may attain 5 mm. in length, including postabdomen; thorax usually found in an extended state, quite transparent and up to half of entire body length, reaching 2.5 mm. in length. Abdomen about two-thirds the length of thorax. Postabdomen short, one-half to two-thirds the length of abdomen. Branchial aperture 6-lobed, atrial aperture situated at level of first transverse vessel or second stigmatal row, small and roundish in outline. Atrial languet very long, protruding from a position far anterior to atrial aperture, its tip simple or bifid. A few delicate longitudinal muscles found only on dorsal part of thorax. Stigmatal rows 12, with 8–12 stigmata in respective rows. Wide space left between endostyle and ventral terminal of stigmatal rows. Ciliated groove a minute oval opening; about 30 very long tentacles. Dorsal languets displaced to left side of dorsomedian line for distance of about two stigmata. No papilla on horizontal membranes along transverse vessels. Anus bilobed, opens at level of seventh or eighth transverse vessel. Stomach smooth-walled, located in anterior part of abdomen;

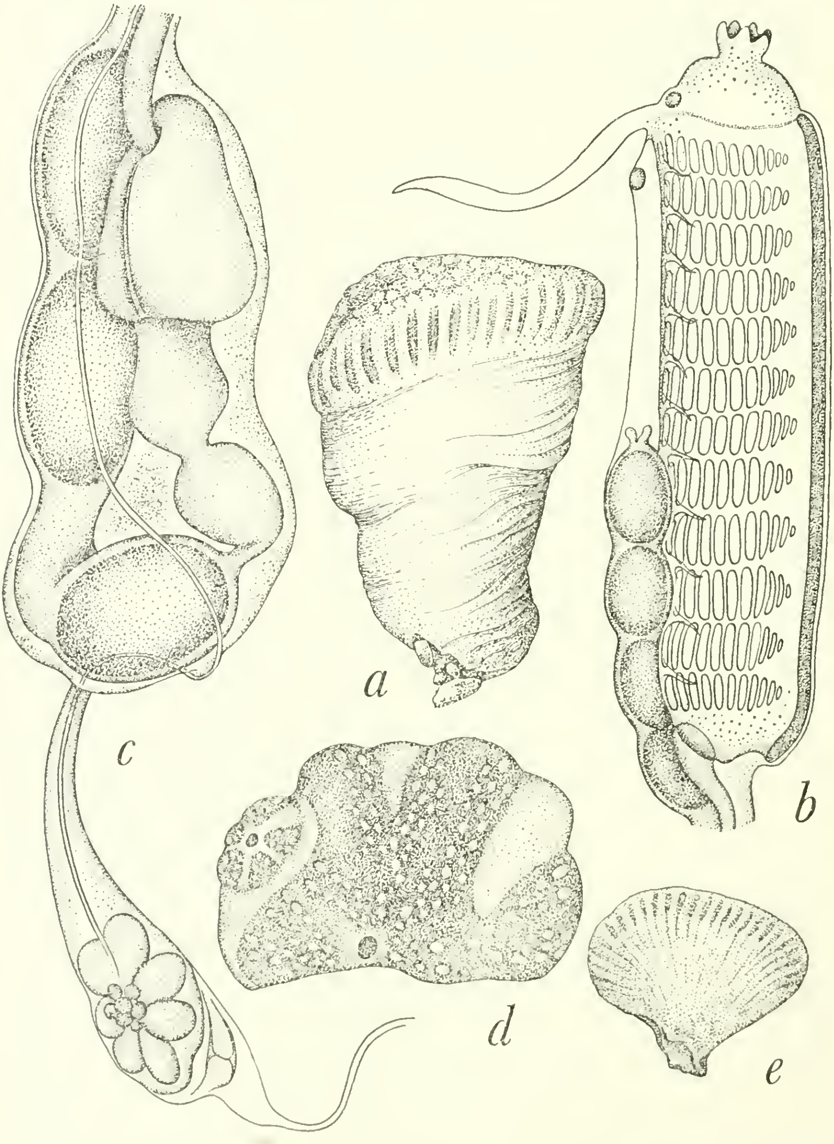

FIGURE 13.—*Aplidiopsis amoyense*, new species: *a*, mushroom-shaped colony; *b*, right side of thorax; *c*, right side of abdomen and postabdomen of same zooid; *d*, upper side of lateral hemisphere of the spherical colony; *e*, section of same colony.

both hind stomach and middle intestine distinct. Proximal end of rectum constricted from middle intestine, but without forming caeca. Intestinal loop may be twisted in some zooids, but not so strongly as in species of the genus *Polyclinum*. Postabdomen a club-shaped prominence issuing from left side of intestinal loop near the posterior end. Ovary situated at or slightly anterior to center of testis; testicular follicles 5–10. Heart situated near rear end of postabdomen, where a long vascular vessel issues.

REMARKS.—The present species clearly resembles *Aplidiopsis tokaraensis* Tokioka from the Tokara Islands near Kyûsyû, Japan, both species having about 12 stigmatal rows. However, the present species shows a distinct system of arrangement of the zooids on the surface of the colony, and the thorax is provided with longitudinal muscles so delicate that thoraces are usually found in an extended state, whereas they are usually found contracted strongly in *A. tokaraensis* because this species is provided with 10–12 strong longitudinal muscles on each side of the thorax. The number of stigmata in each row is much larger in *A. tokaraensis* (18–20) than in the present new species. *Amaroucium variable* Herdman reported by Chin from Amoy may be identical with the present new species as the appearance of the colony of Chin's specimen resembles closely that of the present specimens.

13. *Polyclinum tsutsuii* Tokioka

FIGURE 14

Polyclinum tsutsuii Tokioka, 1954a, p. 240, fig. 1; pl. 18, figs. 1–3.

MATERIAL EXAMINED

PHILIPPINE ISLANDS: Baliwasan; W. R. Taylor, sta. 10. One colony attached to a piece of alcyonarian coral (USNM 11658).

PALAU ISLANDS: Ngerkuid, west of Eil Malk; GVF sta. 261. Two colonies (USNM 11395).

GILBERT ISLANDS: Onotoa Atoll. A. H. Banner, sta. B–8. Two colonies (USNM 11484).

DESCRIPTION.—Three of the colonies are massive, measuring 8 mm. × 4 mm., 10 mm. × 7 mm., and 17 mm. × 5 mm. in extent, and from 4 to 6 mm. in height; a fourth is roughly cylindrical, 2 mm. in diameter and 3 mm. in height. These colonies, except for the last, are encrusted with whitish sand grains over the entire surface or leaving the areas surrounding the common cloacal and branchial apertures exposed. The smallest colony from the Gilbert Islands is quite free from any sand grains and consists of several zooids surrounding the central common cloacal aperture (fig. 14*a*), this and branchial apertures are encircled each by a dark pigmented band. A copepod was found in the test of a colony from the Palau Islands.

Test soft, gelatinous, translucent or transparent, milky white, faintly brownish or grayish brown and containing no sand grains within.

System of zooid arrangement usually obscure due to strong contraction of zooids, although some systems could be discerned rather clearly in dissected colonies. Abdomen about half the length of thorax; postabdomen approximately two-thirds the abdomen length. Branchial aperture 6-lobed, atrial aperture situated near anterodorsal corner of thorax. Tip of atrial languet denticulated with 8 to 10

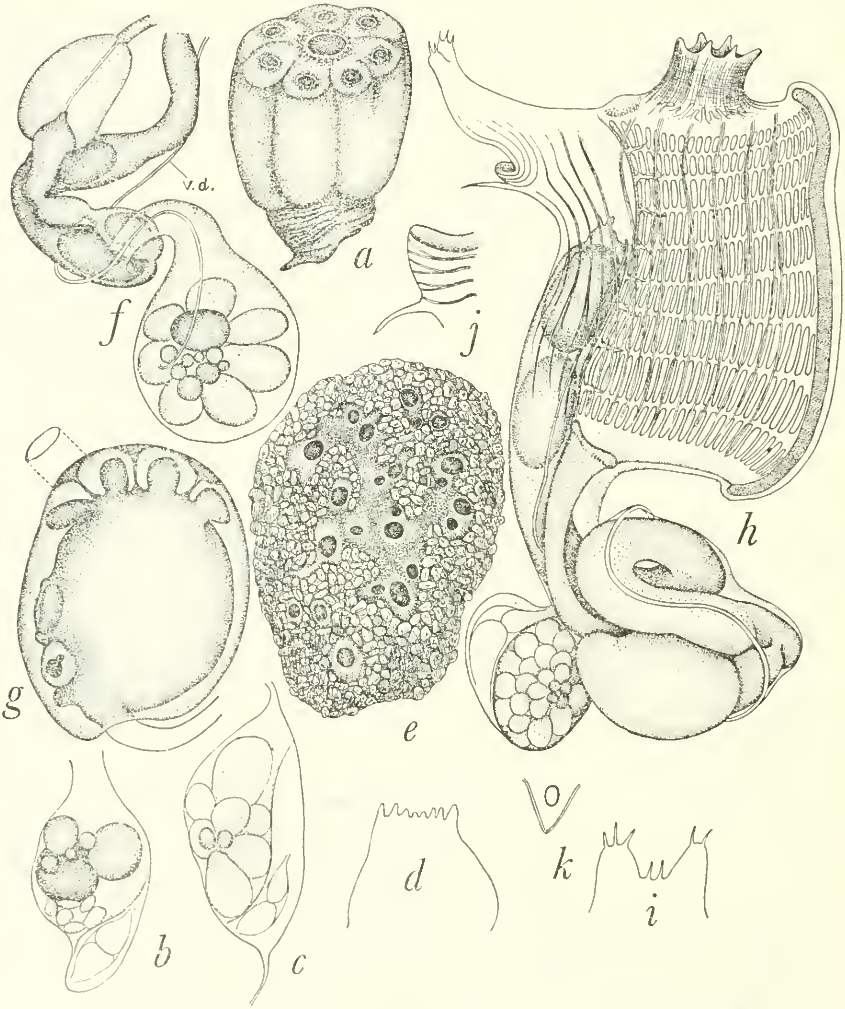

FIGURE 14.—*Polyclinum tsutsuii* Tokioka: *a*, the smallest colony from the Gilbert Islands; *b*, postabdomen of zooid of the 17 mm. × 5 mm. colony from the Gilbert Islands; *c*, postabdomen of zooid of the colony in figure *a*; *d*, tip of atrial languet of the zooid shown in figure *b*; *e*, 10 mm. × 7 mm. colony from the Palau Islands; *f*, abdomen and postabdomen of a zooid of same colony (v.d. = vas deferens); *g*, embryo from same colony; *h*, right side of a zooid of the colony from the Philippine Islands; *i*, tip of atrial languet of same; *j*, small prominence just behind atrial aperture of same; *k*, ciliated groove of same.

small protuberances. About 20 tentacles, larger and smaller ones differentiated, also some minute ones. Ciliated groove a small oval opening. Stigmatal rows 11 on left and 12 on right side in the colonies respectively, 10 mm. × 7 mm. and 8 mm. × 4 mm. in extent, but 8–10 rows in zooids from other colonies; 18 to 25 stigmata in each row. Many papillae along edge of horizontal membranes; approximately 1 papilla at each 1 or 1½ stigmata. Dorsal languets displaced from the dorsomedian line to left side for distance of about 2 stigmata. Anus bilobed and opening at level of sixth transverse vessel. Incubatory pouch at the level of the seventh stigmatal row; usually 2 embryos and 2 mature eggs found in pouches of zooids examined. Ovary usually occupying the center of the testis or situated anteriorly to it when postabdomen contains only a few testicular follicles; testicular follicles up to 19 in zooids examined, but as few as 6 in some zooids of the colony 17 mm. × 5 mm. in extent. Pericardium less than a third of postabdomen in length.

A single embryo was found during dissection, oval in shape and 450μ in length. Three disc-shaped attachment processes are arranged lineally, with elongated outline on the surface. Four pairs of ampullae are distinctly formed. Two pigment flecks of the sensory organ are obliquely arranged (fig. 14*g*).

REMARKS.—In addition to the above-described specimens, a small colony, 6.5 mm. × 5 mm. in extent and 2.5 mm. in thickness (USNM 11658), was found attached to a piece of alcyonarian in a sample of the benthonic organisms collected at Baliwasan, Philippines. The surface of colony is thickly encrusted with sand grains, although the test itself is soft, gelatinous and not impregnated with sand grains. Thorax about 2 mm. in length, abdomen two-thirds to three-fourths the length of thorax. Postabdomen slightly longer than half of abdomen. Branchial aperture 6-lobed. Tip of atrial languet with several fine protuberances as shown in fig. 14*i*. A small but distinct protuberance on dorsomedian line just posterior to atrial aperture. About 10 longitudinal muscles on each side of thorax. Stigmatal rows 9, up to 25 stigmata in each row. Papillae present on horizontal membranes. About 20 very slender tentacles; ciliated groove an oval orifice. Anus attached at level of fourth transverse vessel, but extending slightly anterior from this level. Ovary central (?), testicular follicles as many as 50. Pericardium about one-fourth the length of postabdomen. This specimen differs from the typical *P. tsutsuii* by having fewer stigmatal rows, the anus is situated more anterior and the postabdomen contains many more testicular follicles. These features are, however, hardly regarded as being of specific significance; probably the present specimen represents an extremity of intraspecific variation.

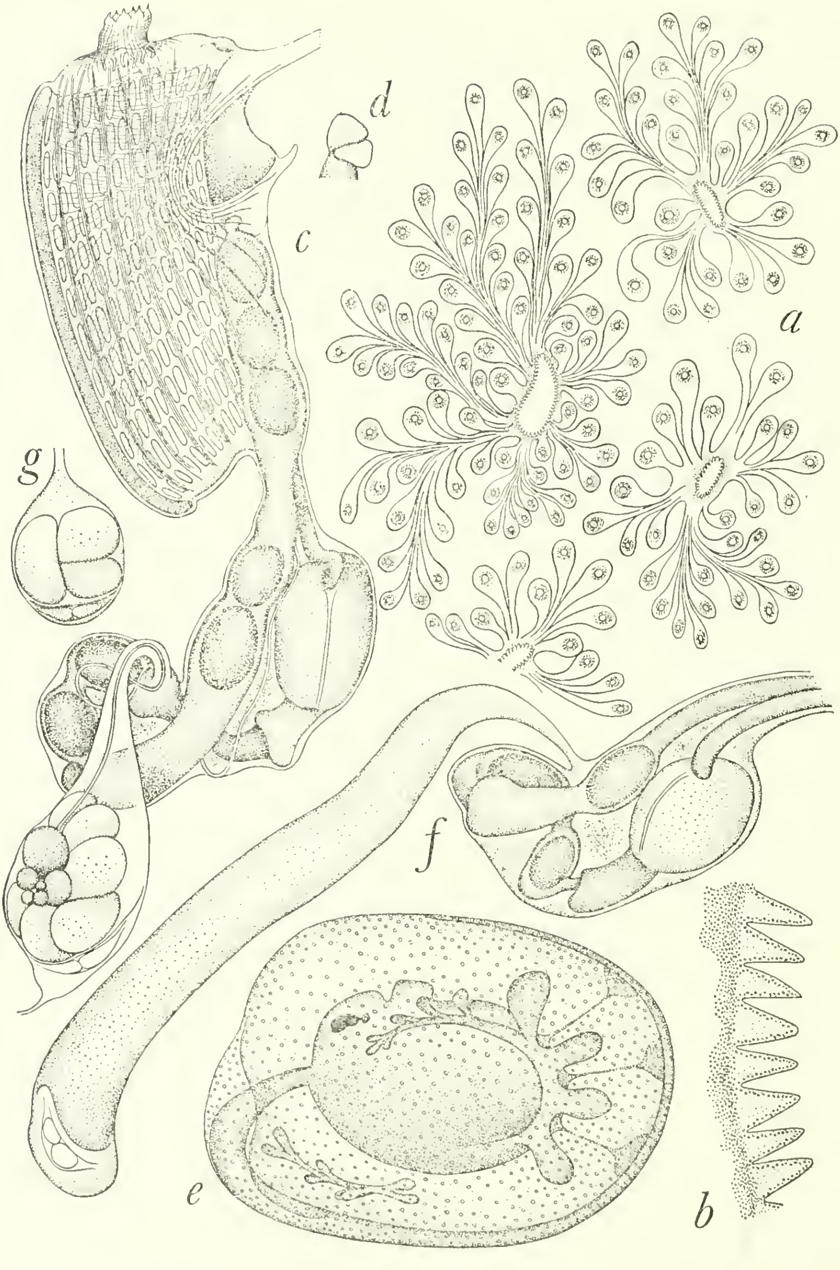

FIGURE 15.—*Polyclinum vasculosum* Pizon: *a*, systems of zooids on colony from Pearl Harbor; *b*, part of margin of common cloacal aperture on colony from Saipan Island, magnified; *c*, left side of zooid of same; *d*, anus of same zooid; *e*, right side of embryo from the 11 mm. × 8 mm. colony from the Philippine Islands, × 240; *f*, long postabdomen of a zooid of the 8 mm. × 4.5 mm. colony from Saipan Island; *g*, small postabdomen containing only three testicular follicles from same colony.

14. *Polyclinum vasculosum* Pizon

FIGURE 15

Polyclinum vasculosum Pizon, 1908, p. 223.
Polyclinum laxum Van Name, 1945, p. 71.

MATERIAL EXAMINED

PHILIPPINE ISLANDS: Baliwasan; W. R. Taylor, sta. 10. Two colonies measuring 11 mm. × 8 mm. and 4.5 mm. × 3 mm. in extent, attached to eelgrass (USNM 11648).

MARIANAS ISLANDS: Saipan, entrance of Tanapag Lagoon; P. E. Cloud, sta. D–7. Nine colonies, the larger ones from 55 mm. × 20 mm. to 40 mm. × 25 mm. in extent and 3.5 mm. to 6 mm. in thickness (USNM 11540).

HAWAIIAN ISLANDS: Oahu, Pearl Harbor; Paul Bartsch, collector, September 1920. Six colonies, the larger ones roughly massive, 18 mm. × 11 mm. to 15 mm. × 12 mm. in extent and 8–10 mm. in thickness; attached to hydrozoan colony (USNM 11755).—Oahu; T. H. Streets, collector. Three large colonies, the largest measuring 145 mm. × 110 mm. in extent and 25 mm. in thickness (USNM 11782).

DESCRIPTION.—Colonies from the Hawaiian Islands are rather massive, attached to substratum by the underside; the place of attachment may be narrowed in some colonies and carries sand grains along its margin. The upper surface of the colony is smooth and quite free from foreign matter in some specimens, but it carries a small amount of fine sand grains in others. The system of arrangement of zooids consists of several radial canals converging in a common cloacal aperture situated at the center of the system; many zooids are arranged along both sides of these canals as shown in figure 15*a*. The largest system examined holds 137 zooids, while the smallest colony, about 3 mm. long, consists of a single system containing only 18 zooids. The 15–18 mm. × 11–12 mm. colonies contain about 6 systems on the surface. These systems are defined distinctly by their yellowish coloration attributable to the pigmentation on the upper side of thoraces and atrial languets of zooids; the branchial apertures are surrounded by markings of brownish pigment. The systems are 15 to 25 mm. in diameter on large colonies from Oahu Island.

Colonies from Saipan Island are encrusted and thinner than those from the Hawaiian Islands; the surface is covered with fine sand grains in various degrees. One of the colonies from the Philippine Islands carries sand grains sparsely over the whole surface, while the other holds sand grains only along the margin of the colony, leaving the area containing zooids quite exposed. There is a single common cloacal aperture on each colony and the zooids seem to be arranged in a stellate system, although it is uncertain whether this system is a typical stellate one as found in *P. tsutsuii*, or a complicated configuration as seen in smaller colonies from the Hawaiian Islands, because the condition of preservation is not perfect. Common cloacal aperture up to 1.5 mm. in diameter and bordered with many fine finger-shaped protuberances along the margin (fig. 15*b*); the margin of these fine protuberances is sprinkled with dark pigment.

Test soft, gelatinous, translucent, milky white, brownish or dark brownish; the coloration varies according to amount of pigment cells; no sand grains embedded in test. Zooids, yellowish orange, brown or grayish brown, are seen through the test. Zooids rather small, thorax 1.7 mm.–2 mm. in length in somewhat contracted state. Abdomen usually one-half to two-thirds the length of thorax, but may be as long as thorax in some zooids. Postabdomen usually smaller than abdomen, approximately half the length of abdomen, although in a fully mature state it reaches the length of abdomen. In the small colony from Saipan Island, 8 mm. × 4.5 mm. in extent and 4.5 mm. in thickness, some zooids are provided with an elongated postabdomen which may be as long as thorax (compare fig. 15*f* with fig. 15*g*); these long postabdomens are filled with mesenchyme cells, but contain no mature gonads. Probably this feature is due to an unusual overgrowth. Branchial aperture 6-lobed, atrial aperture situated at level of first to third transverse vessel. Atrial languet long, but exact length and shape of tip are unknown, as no zooids could be taken from the test perfectly with the atrial languet whole. Small prominence found on the dorsomedian line just posterior to atrial aperture. Six strong longitudinal muscles on each side of thorax, also a few delicate ones on dorsal side. Extremely delicate fibrous structures running transversely or obliquely between endostyle and atrial aperture faintly discernible on some zooids, but it is not yet ascertained whether the structure is truly muscular or not. Stigmatal rows usually 12–13, ranging from 10 (Philippine specimens) to 15 (specimen from Oahu Island); 12–20 stigmata in each row. Papillae on horizontal membranes along transverse vessels, arranged roughly one for each stigma; in some zooids tip of papillae sometimes colored by aggregated whitish corpuscles. Tentacles 12–22 in zooids examined, including larger and smaller ones, sometimes marked by whitish pigment spots. Ciliated groove a small elliptical opening. Dorsal languets not large, situated approximately on dorsomedian line or slightly displaced from median line to the left for the distance of about two stigmata. Anus bilobed, opening at the level of the seventh transverse vessel (exceptionally at the sixth transverse vessel). Four to five embryos, mature and immature, found in zooids of the colonies from Oahu Island. Intestinal loop twisted as usual in species of the genus *Polyclinum*. Distal portion containing pericardium rather small, scarcely reaching half the length of postabdomen. Ovary is centered; testicular follicles 3–11 in specimens from Saipan Island, but 12–39 in specimens from the Hawaiian Islands.

Larvae elliptical in shape, 420–580μ in length. Test somewhat frothy in younger stages, but somewhat granulated in grownup stages.

Three cup-shaped attachment processes arranged lineally, oval in outline on surface. Four pairs of ampullae present. In fully grown larvae, dorsal end of ampulla vessel on each side extends posteriorly almost to sensory organ, producing several small vesicles on the way; in addition, an isolated short vessel is at the posteroventral part of the trunk, which produces four pairs of small vesicles (fig. 15*e*). Dorsal branches of the ampullae vessels and the isolated posteroventral vessel not found in younger embroyos. Two pigment flecks of sensory organ arranged anteroposteriorly.

REMARKS.—The structure of zooids in the present species resembles closely that of *P. tsutsuii.* The only clear difference between these two species is in the appearance of systems which are stellate, quite simple, and consisting of a small number (4 to 12, usually 6 to 8) of zooids in *P. tsutsuii*, but in *P. vasculosum* they are considerably complicated, even in young and small colonies (see description of the 3 mm. long colony from Pearl Harbor, p. 51). However, when the specimens are not preserved perfectly enough to examine the appearance of zooid systems, smaller colonies of these two species are confused and exact identification is practically impossible. *Polyclinum neptunium* Hartmeyer and *P. macrophyllum* Michaelsen also resemble the present species in having 12–13 stigmatal rows, but in those species the systems are "Doppelreihen-netzsystemen."

15. *Polyclinum constellatum* Savigny

FIGURE 16

Polyclinum constellatum Savigny, 1816, p. 189, pl. 4, fig. 2; pl. 18, fig. 1.—Van Name, 1921, p. 299, figs. 1, 2.—Michaelsen, 1923, p. 8.—Van Name, 1930, p. 422, fig. 3.—Van Name, 1945, p. 68, fig. 28.

Polyclinum festum Hartmeyer, 1905, p. 400, pl. 13, figs. 6–7.—Van Name, 1918, p. 162, fig. 111.

MATERIAL EXAMINED

JAPAN: Off Omai Zaki, Honshu; *Albatross* sta. 3730. One colony, a roundish mass 17 mm. × 11 mm. in extent and 9 mm. in height, of a soft, gelatinous consistency and yellowish white, with a sparse coating of sand grains on the surface (USNM 11630).

PALAU ISLANDS: Eastern end of Urukthapel Is.; GVF sta. 28. One specimen 13 mm. x 12 mm. in extent and 5.5 mm. in thickness; entire surface densely covered with coarse, white sand grains about 0.5 mm. in diameter (USNM 11456).

GILBERT ISLANDS: Onotoa Atoll; A. H. Banner, sta. B–4. Five colonies, the larger ones from 33–35 mm. × about 20 mm. in extent, and 8–12 mm. in thickness; cushion-shaped and attached to colonies of zoanthids or attached to coral sand grains beneath; surface of colonies encrusted with sand grains to various degrees, very heavily in some colonies (USNM 11518).

DESCRIPTION.—Test soft, gelatinous, translucent or transparent, and yellowish white to brownish. Surface coated with sand grains in varying degrees but never impregnated with them, except for some colonies in which sand grains and fecal pellets are embedded in the

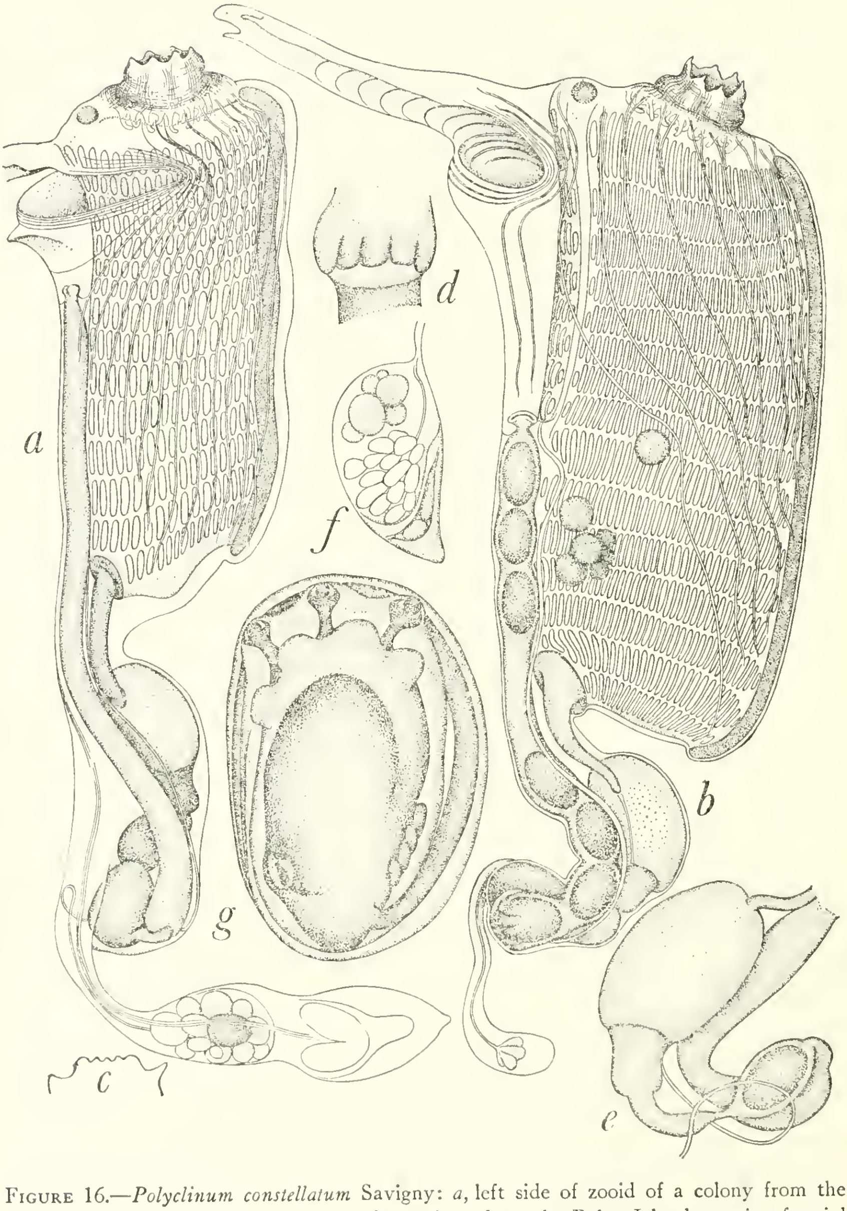

FIGURE 16.—*Polyclinum constellatum* Savigny: *a*, left side of zooid of a colony from the Gilbert Islands; *b*, left side of a zooid of colony from the Palau Islands; *c*, tip of atrial languet of a zooid of same colony; *d*, outer side of proximal part of rectum of same zooid; *e*, intestinal loop of a zooid of the colony from Japan; *f*, postabdomen of same zooid; *g*, embryo from same colony.

hypoabdominal layer near the bottom. Test sometimes irregularly thickened at random on surface. Zooids transparent and pinkish or quite colorless in preserved specimens. Thoraces situated perpendicularly, while abdomens are placed obliquely. Abdomens one-half to two-thirds the length of thoraces; postabdomen mostly as long as abdomen. Thorax about 2.5 mm. in length in zooids examined in the colony from Japan, whereas in some zooids of the colony from the Palau Islands it reaches 5 mm. and abdomen attains 2 mm. System of zooid arrangement obscure in all specimens, because entire surface is encrusted with sand grains. Branchial aperture 6-lobed and atrial aperture situated at level of the first to fourth stigmatal row. Atrial languet very long, its tip simple, trifid or bluntly truncated and with several small prominences as shown in figure 16*c*. A small prominence may be found on dorsomedian line just posterior to atrial aperture. Up to a dozen longitudinal muscles on each side of thorax, of which 6 to 10 ventral ones are rather thick, whereas the dorsal ones are somewhat delicate. Stigmatal rows 14 to 18, usually 15; generally 15 to 20 stigmata in each row, although as many as 40 in some zooids of the colony from the Palau Islands. Papillae on the horizontal membranes very distinct, usually arranged one to each one or two stigmata. Tentacles 16 to 24 in the zooids examined, larger and smaller ones alternating regularly. Ciliated groove a small elliptical opening. Dorsal languets situated along dorsomedian line or in some zooids somewhat displaced from midline to left side for distance of 4 stigmata. Anus bilobed and opening at level of seventh or eighth transverse vessel, except at level of the thirteenth transverse vessel in zooids having 17–18 stigmatal rows. Three to seven fertilized eggs or embryos in various developmental stages found in incubatory pouch. Surface of stomach smooth. Proximal portion of rectum somewhat swollen, forming a pair of small caeca in some zooids; outer side of this swollen portion sometimes cut faintly into 5 lobules (fig. 15*d*). Rectal wall in region between level of the cardiac end of stomach and middle constriction of hind stomach surrounded by whitish circumintestinal glands. Ovary usually situated at the center of testis, but anterior to testis in some zooids. Testicular follicles generally 15–31, although in zooids of the colony from the Palau Islands there are only four and all very small. Posterior part of postabdomen, containing pericardium, occupies one-third to two-thirds of postabdomen.

Larvae elliptical in shape and from 460 to 520μ in length. Four pairs of low ampullae present. Three cup-shaped attachment processes arranged lineally; oval in outline on the surface. Four pairs of small vesicles found at posteroventral part of trunk in embryos from the Japanese colony. Sensory organ situated at the level of posterior one-fourth to one-third of the trunk; two pigment flecks arranged anteroposteriorly (fig. 16*g*).

Remarks.—Although the system of arrangement of the zooids is quite obscure in all of the present specimens, the existence of a long atrial languet in most of the zooids examined seems to suggest that it may be of the complicated kind found in colonies of *Polyclinum vasculosum*. Zooids of the present species are characterized by a larger number of stigmatal rows as compared with *P. vasculosum* (15 instead of 12–13). Although the number of stigmatal rows in the two species may be continuous through some forms containing zooids with an intermediate number of rows, these intermediate forms are very scarce as compared with the two typical forms having characteristic number of stigmatal rows. For this reason, I prefer, at present, to separate these species as Van Name did.

16. *Ritterella* sp. aff. *aequalisiphonis* (Ritter & Forsyth)

Figure 17

?*Amaroucium aequali-siphonis* Ritter and Forsyth, 1917, p. 487, pl. 38, fig. 4; pl. 45, fig. 61.

?*Sigillinaria aequali-siphonis* Van Name, 1945, p. 74, fig. 31; pl. 28, fig. 1.

MATERIAL EXAMINED

Japan: Hokkaido Island, Hakodate; E. S. Morse, collector. Many colonies (USNM 11787).

Description.—Many pieces of colonies encrusted on gravel; the largest is 90 mm. × 55 mm. in extent. Each consists of several club-shaped cormidia ending in roundish tips, the larger cormidia 11–12 mm. in diameter, 15–20 mm. in length, dark reddish brown or dark brownish.

Test rather hard and cartilaginous, impregnated with sand grains, especially dense in the basal portion but sparse in the distal portion of the cormidia; surface sparsely encrusted with sand grains. The system of zooid arrangement is quite obscure because the specimens are preserved rather poorly. Many amphipods were found boring in the test of some colonies. Zooids mostly seem to be in resting stage; all thoraces missing, abdomens and postabdomens found embedded in a kind of the mesenchyme tissue. Remaining bodies usually 4.5 mm. in length; postabdomen seems to be long. Only a few small zooids in some small and soft cormidia were found in nearly perfect condition, retaining the thorax; they are less than 3.5 mm. in length, the abdomen about 1½ times the length of thorax, which is contracted and has approximately 14 stigmatal rows. Stomach elongated, with 8 longitudinal plications on the surface besides typhlosolis, situated near middle of abdomen. A pair of distinct caeca found at proximal end of rectum.

Remarks.—The existence of 14 stigmatal rows and 8 longitudinal plications on the stomach shows the close resemblance to *Amaroucium solidum* Ritter & Forsyth (13–15 stigmatal rows and about 8 longitudinal plications on the stomach) from California coast and *A. dubium*

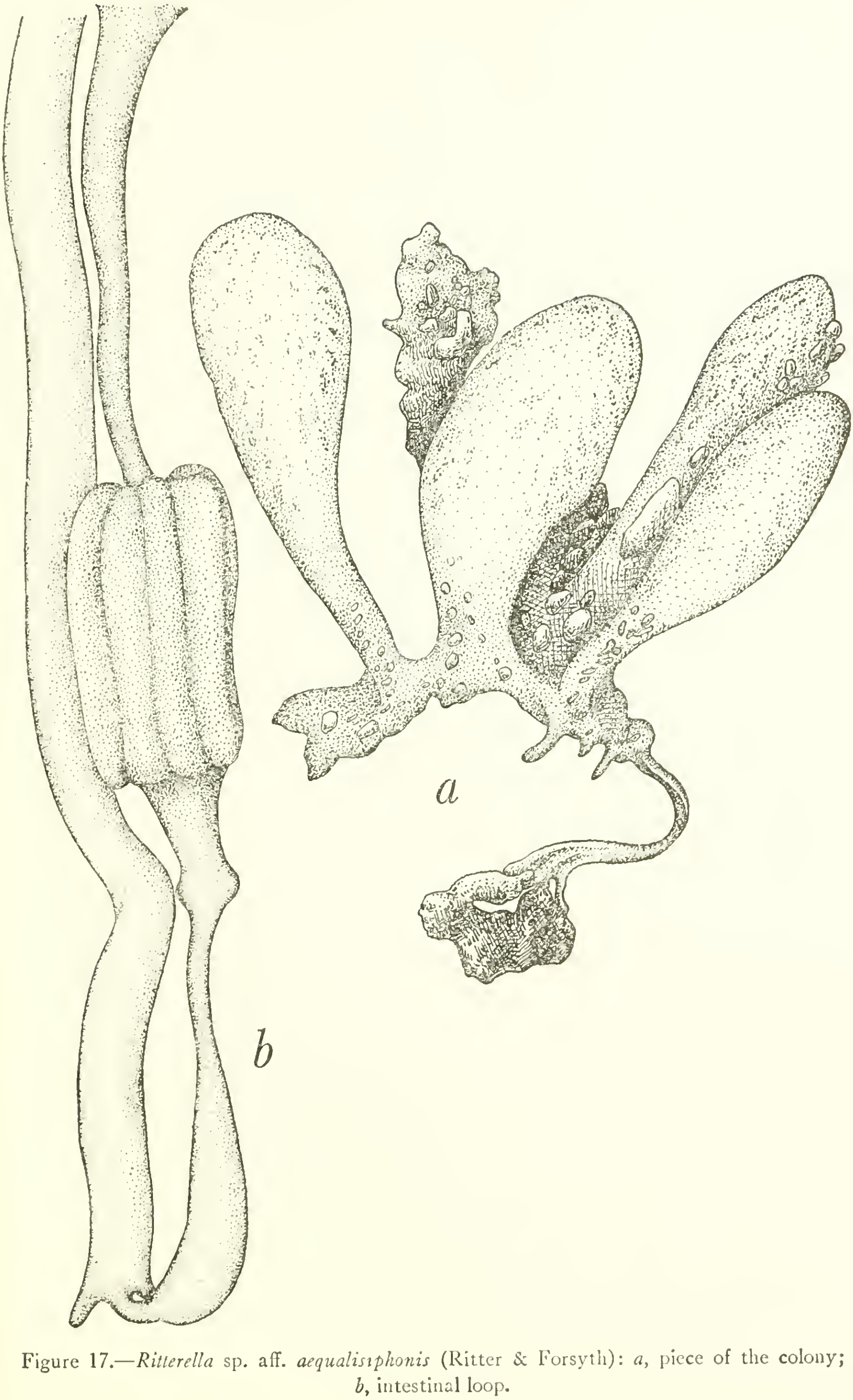

Figure 17.—*Ritterella* sp. aff. *aequalisiphonis* (Ritter & Forsyth): *a*, piece of the colony; *b*, intestinal loop.

Ritter (10–12 stigmatal rows and 10–12 longitudinal plications on the stomach) from the Commandor Islands group in the Bering Sea. However, the characteristic appearance of the colony in the present specimens seems to differ from that of two species of *Amaroucium*. *A. coei* Ritter from Alaska has 11–16 stigmatal rows and the appearance of the colony somewhat resembles that of the present form, though the test is quite free from sand grains. But the exact number of the longitudinal plications on the stomach is unknown in *A. coei*, which prevents a close comparison between these two forms. *A. fragile* Redikorzev from the Okhotsk Sea has 10–11 stigmatal rows and the colony consists of a number of cormidia encrusted with sand grains, but the stomach is provided with only 4–5 plications. Above all, the greatest difficulty in identifying the present specimens results from the fact that the thorax is too strongly contracted to determine whether the atrial aperture opens into the common cloaca or directly to the surface. On the other hand, the colonial form of the present specimens is met with commonly in species of *Ritterella* (=*Sigillinaria*), known chiefly from cool or cold waters. Especially the shape of each cormidium and the consistency of the test in the present specimens conform very well with those of *Amaroucium aequalisiphonis* Ritter and Forsyth from the California coast; stigmatal rows are 8–10 and longitudinal plications on the stomach are never more than 6 or 7 in the California species. There is still a slight gap in the number of stigmatal rows between the California species and the present specimens, but I am inclined, at present, to regard the specimens described here, provisionally, as a form close to *A. aequalisiphonis*.

17. *Euherdmania digitata* Millar

FIGURE 18

Euherdmania digitata Millar, 1963b, p. 698, fig. 7.

MATERIAL EXAMINED

PALAU ISLANDS: Iwayama Bay, west shore of Island XXII opposite west peninsula of Island XX; 7°19′35″ N., 134°29′ 53″ E. (HO chart 6076, 2nd ed.); depth 3–10 feet, living and dead coral bottom; GVF sta. 218, October 10, 1955 (USNM 11464).

DESCRIPTION.—A single elongate specimen measuring 40 mm. in length consists of only two zooids arranged as shown in figure 18*a*. The portion containing the thoraces is somewhat stouter and raised from the substrate, while the portion containing the abdomens is quite thin, creeping on the surface of an empty shell. Both branchial and atrial apertures open at the distal end of the zooidal sheath.

Test rather hard, yellowish white and translucent; surface generally smooth, though wrinkled by contraction, quite free from foreign matter. Thoracic portions longer than 5 mm. Zooids 15 mm. in length in a contracted state, of which 3.5 mm. constitutes the thorax;

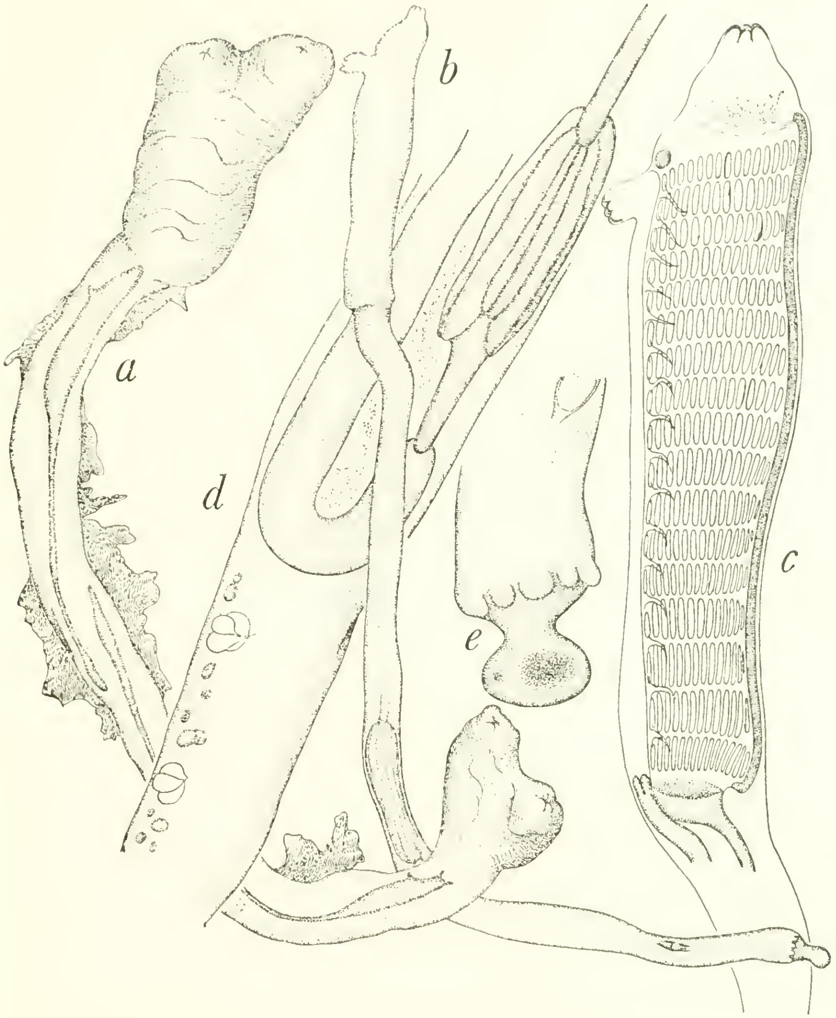

Figure 18.—*Euherdmania digitata* Millar: *a*, entire colony; *b*, right side of a zooid; *c*, right side of thorax; *d*, right side of posterior half of abdomen and anterior half of postabdomen; *e*, distal end of postabdomen.

probably at least 22 mm. in length when alive and extended. Zooids orange brown as a whole, partially sprinkled with violet-brown pigment, firmly embedded in the test and surrounded by tissue containing densely reddish-orange corpuscles. No remarkable constriction between the thorax and abdomen or between abdomen and postabdomen. Postabdomen about half as long as abdomen. Both apertures 6-lobed, atrial aperture opening at tip of a short siphon situated at level of anterior end of brachial sac. A number of longitudinal muscles on each side of the thorax, the exact number could not be counted clearly.

Stigmatal rows 17, and about 15 (?) stigmata in each row. No papillae along transverse vessels. About a dozen tentacles, besides some smaller ones (?). Ciliated groove a longitudinal slit. Dorsal languets finger-shaped and arranged along the dorsomedian line. Anus opens at the dorsoposterior corner of brachial sac. Stomach elongated and situated near the posterior end of the intestinal loop approximately at middle of region containing both abdomen and postabdomen, separated from rear end of loop by distance of stomach length; surface marked with 8 longitudinal plications, also 2 typhlosolis. Hind stomach defined distinctly, but region of middle intestine quite obscure. Two groups of testicular follicles, each consisting of only a few follicles, found posterior to intestinal loop. Heart situated at level of posterior one-third of postabdomen. Distal end of postabdomen somewhat swollen where it contains corpuscles densely; nine small knobs found around base of swollen portion.

Remarks.—*Euherdmania claviformis* (Ritter) from the California coast has about 12 stigmatal rows and up to 40 stigmata in each row, therefore fewer rows and many more stigmata in each row than in this species. These differences are considered, at present, to be too remarkable to be regarded as intraspecific variations.

18. Polyclinid in strobilization (?)

Figure 19

MATERIAL EXAMINED

Korea Straits: *Albatross* sta. 4876. One specimen (USNM 11813).

Description.—The single colony is roughly ovoid in shape, about 10 mm. in height and attached to the substratum by a slightly narrowed basal end.

Test very soft, gelatinous, and pale yellowish brown; encrusted with sand grains on the surface, but not impregnated. No system found in arrangement of zooids. Zooids less than 5.2 mm. in length and all in a degenerated state, respective parts of zooids difficult to discern properly. Probably anteriormost elongated and tapering part, about 1.2 mm. in length, is atrial languet, and following thickest portion, about 3 mm. in length, may represent thorax proper, on which about 20 rows of rudimentary or vestigial stigmata are seen faintly. Both branchial and atrial apertures obscure, although branchial aperture may be situated just anterior to stigmatal rows. Next segment approximately 1 mm. in length, striated faintly with a few longitudinal muscles (?) and followed by a short sausage-like part. The former may represent the abdomen and the latter a part of the postabdomen. A small prominence found at the juncture of thorax and abdomen on the dorsal (?) side is considered to represent either the anus or a vestige of the retractile muscle of the thorax.

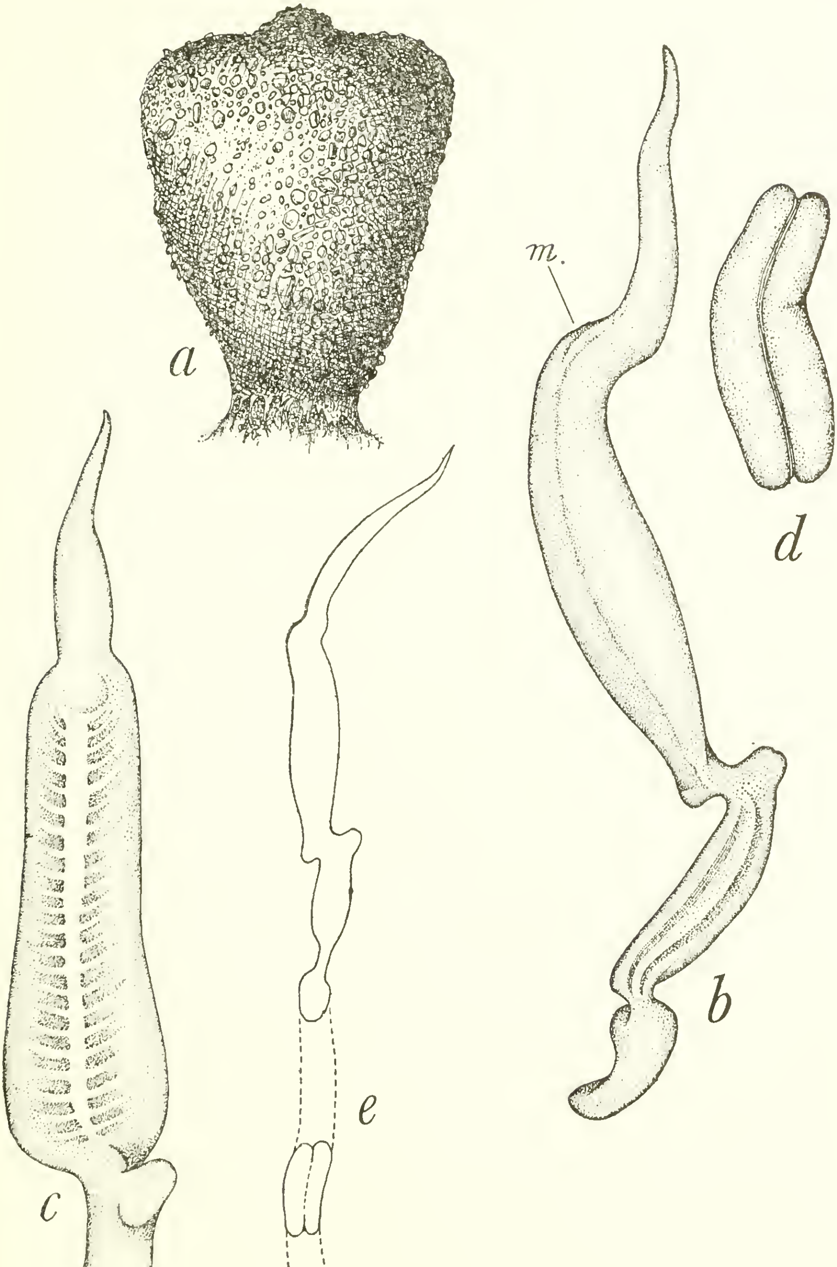

Figure 19.—Polyclinid in strobilization (?): *a*, entire specimen; *b*, left (?) side of a degenerating zooid (m = branchial aperture (?)); *c*, dorsal (?) side of 3 mm. thorax; *d*, piece of postabdomen in strobilization; *e*, schema showing possible connection between degenerating zooid and pieces of postabdomen in strobilization.

In addition to the above-mentioned zooids, many small pieces less than 1.5 mm. in length and orange red (fig. 19*d*) are found abundantly embedded in the basal part of the colony; probably these are pieces of postabdomen in strobilization.

Remarks.—The existence of many stigmatal rows, large atrial languet, and probably of long postabdomen shows that the present specimen belongs to a form of the family Polyclinidae, although further generic or specific identification is quite impossible.

Family Didemnidae

19. ***Didemnum (Didemnum) candidum*** **Savigny**

Figures 20*a–c*

Didemnum candidum Savigny, 1816, pp. 14, 194, pl. 4, fig. 3; pl. 20 fig. 1.—Michaelsen, 1919, p. 18.—Van Name, 1921, p. 323, figs. 16–25.—Van Name, 1930, p. 435, figs. 13–14.—Hastings, 1931, p. 94, fig. 13; pl. 2, fig. A.—Van Name, 1945, p. 83, fig. 35; pl. 13, fig. 4.—Tokioka, 1954a, p. 246, pl. 22, figs. 4–6; pl. 23, figs. 1–7.—Tokioka 1955b, p. 45, fig. 1; pl. 2, figs. 10–17.

?*Didemnum recurvatum* Sluiter, 1909, p. 51, pl. 3, figs. 19–20.

MATERIAL EXAMINED

Philippine Islands: Cebu, Talisay; H. C. Kellers, Eclipse Expedition, April 17, 1929, 6 small colonies (USNM 11746), and 50 minute specimens attached to carapace and legs of decorator crab (USNM 11745).—Basilan Island, Tundun Pasil, near lighthouse at Isabela Channel; W. R. Taylor, January 1941, one colony (USNM 11682).—Manicaan, 3 fathoms; W. R. Taylor, January 1941, one colony (USNM 11644).—Baliwasan; W. R. Taylor, sta. 10, several colonies (USNM 11652).—Cabaluay, near mouth of Cabaluay River; W. R. Taylor, sta. 14, three colonies (USNM 11670).—Punta Natangol, Basilan Island; W. R. Taylor, sta. 31, four colonies (USNM 11665).—Kilay Island, near Langos Island; W. R. Taylor, sta. 38, three colonies (USNM 11679).—Balukbuluk Island; W. R. Taylor, sta. 40, three colonies (USNM 11635).—Boboh, near Matanal Point; W. R. Taylor, sta. 41, one colony (USNM 11675).

Palau Islands: Barrier reef 8 mi. NW. of Koror Island; GVF sta. 25, six colonies (USNM 11383).—Iwayama Bay, south end of Island XX; GVF sta. 134, 10 colonies (USNM 11460).—Iwayama Bay, east side of Oyster Pass; GVF sta. 220A, two colonies (USNM 11453).—Fringing reef of small island in Eil Malk Lagoon; GVF sta. 252, one large colony encrusting *Polycarpa cryptocarpa* (Sluiter) (USNM 11433) and one other colony (USNM 11432).

Gilbert Islands: Onotoa Atoll; A. H. Banner, sta. B–4, 4 colonies (USNM 11515); P. E. Cloud, sta. GOC–55, 22 colonies (USNM 11498) and 1 colony (USNM 11520); P. E. Cloud, sta. GOC–59, many colonies encrusting reef corals (USNM 11514).

Hawaiian Islands: Pearl and Hermes Reef; P. S. Galtsoff, sta. T. H. 60, August 8, 1930, many colonies (USNM 11765).

Galapagos Islands: Albemarle Island, Cartage Bay; Hancock Galapagos Exped. sta. 189, collectors Bob Irwin and H. W. Manter, January 22, 1934, one colony from carapace of *Dromidia larraburei* Rathbun with carapace length 15 mm. (Crust. cat. no. 69241) (USNM 11783).

Description.—Many large and small colonies from the Philippine, Gilbert, Palau, and Hawaiian Islands, and a single colony from the

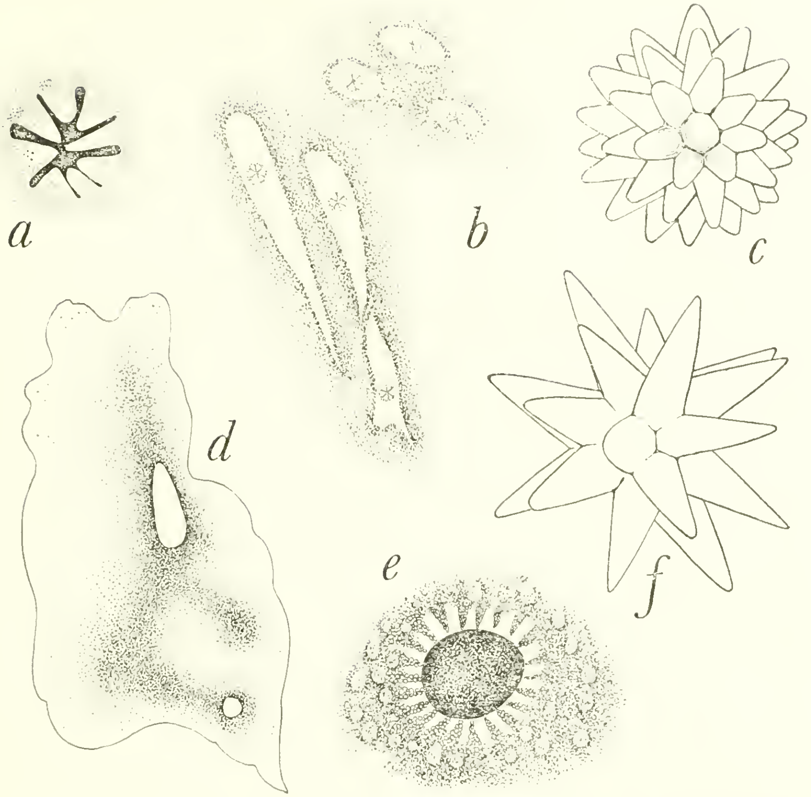

FIGURE 20.—*a–c*, *Didemnum* (*Didemnum*) *candidum* (Savigny): *a*, common cloacal aperture fringed with lobules, Hawaiian colony; *b*, patterns made by pigmentless areas around branchial apertures, Palau specimen; *c*, spicule from colony from the Palau Islands, × 1800. *d*, *Didemnum* (*Didemnum*) *moseleyi* (Herdman): colony heavily pigmented dark brown, common cloacal apertures well defined on white hypoabdominal layer, Palau Islands, sta. 134. *e*, *f*, *Didemnum* (*Didemnum*) *moseleyi* f. *granulatum* Tokioka; *e*, cloacal aperture supported by riblike structures made of spicules; *f*, spicule from colony from sta. 220, × 1800.

Galapagos Islands were examined. The largest specimen in the collection is 40 mm.×70 mm. in extent; thickness usually 1 mm., but sometimes up to 2 mm. around the periphery or in some parts of the colonies. The animal encrusts reef corals, brown algae, the carapaces of crabs, or the surface of solitary ascidians (e.g., *Polycarpa cryptocarpa*, as in the present material). They are usually irregularly lobed and, as a whole, the surface is smooth, though it may be depressed slightly at the branchial aperture of each zooid or, contrastingly, slightly elevated above strongly contracted zooids so that it assumes a rough appearance as seen in one of the specimens from Palau. Generally, the superficial spicule-free layer is extremely thin or practically indiscernible; only in the specimen from the Galapagos Islands is it somewhat prominent. The common cloacal apertures are about 2 mm. in diameter in larger examples and may be fringed with several lobules as shown in a Hawaiian specimen (fig. 20*a*). Usually, the spicules are distributed densely and evenly throughout the colony from the bottom to the surface, although they are rather sparse in the colony from the Galapagos and in some from the Palau Islands—especially so above the zoids in the latter. The spicules may reach 35–48μ in diameter as in the Hawaiian and some Palauan specimens, although they are usually much smaller, for instance, 16–17μ to 22–24μ in diameter in many specimens from the Palau Islands. Their rays are short, delicate, and very numerous, usually more than 20 on the equatorial plane; rarely a few spicules are found with somewhat fewer rays, 12–15 on the equatorial plane, in some colonies from the Hawaiian and Palau Islands. Some colonies contain worn spicules quite spherical in shape and with a fine areolate appearance on the surface. The color of the colonies varies from pure white to bright carmine red or sometimes tinted purplish; this coloration fades very quickly in preservation. Preserved colonies are snowy white, grayish white, pale yellowish brown, faintly yellowish gray, pale greenish gray, pale orange, or even dark purplish brown in color. Pigment cells are deposited most densely in the surface layer of the zooidal stratum, corresponding to the thoracic layer, but generally are missing in the abdominal layer and along the periphery of the colony. On the purplish-brown colony from the Palau Islands, encrusting *Polycarpa cryptocarpa* (Sluiter), pigment cells are missing in small oval or elongated areas surrounding the branchial apertures in some parts of the colony and consequently the surface of the test shows a kind of spotted appearance (fig. 20*b*). Hypoabdominal lacunae absent.

Zooids rather small and sometimes stained dark grayish or brownish. Larger abdomens may reach 600μ in length. Branchial aperture 6-lobed, atrial aperture very wide and without any languet; retractile muscle usually short, but may be as long as contracted throax in some zooids. About 7 stigmata in each of 4 stigmatal rows. Usually a single testicular follicle in zooids from the colonies from the Philippine, Galapagos, Hawaiian, and Palau Islands, while 2 or 3 follicles were found in the specimens from the Gilbert Islands; in the latter one of the 11 zooids examined had a single follicle, nine had 2 follicles and the rest 3 follicles. The proximal part of vas deferens coils 4–5 to 8–9 times. The general structure of the zooids conforms well in detail with that of common didemnids.

Four pairs of ampullae present in larvae.

20. *Didemnum (Didemnum) moseleyi* (Herdman)

FIGURE 20*d*

Leptoclinum moseleyi Herdman, 1886, p. 272, pl. 37, figs. 9–14.

Didemnum moseleyi Sluiter, 1909, p. 45.–Van Name, 1918, p. 151, figs. 102–103.—Tokioka, 1949b, p. 43, fig. 3.—Tokioka, 1953a, p. 185, pl. 15, figs. 1–8; pl. 16, figs. 1–11; pl. 17, figs. 1–6.—Tokioka, 1954a, p. 243, pl. 20, figs. 2–7.—Tokioka, 1954b, p. 77, fig. 1.—Tokioka, 1955a, p. 212, pl. 14, figs. R–S.—Tokioka, 1955b, p. 44, pl. 1, figs. 6–9.—Tokioka, 1959a, p. 30.

Didemnum (Leptoclinum) moseleyi Sluiter, 1914, p. 74.

?*Leptoclinum albidum* var. *grande* Herdman, 1886, p. 291, pl. 35, figs. 11–14.

?*Didemnum grande* Van Name, 1918, p. 148, figs. 98–101; pl. 30, figs. 20–23.

MATERIAL EXAMINED

JAPAN: Tsugaru Strait, off Cape Tsiuka; *Albatross* sta. 4808. Six colonies attached to seaweeds and bryozoan (USNM 11633).—Hokkaido, off Kamoi Misaki Light; *Albatross* sta. 4987. One colony (USNM 11743).

PHILIPPINE ISLANDS: Baliwasan; W. R. Taylor, sta. 10. Several colonies (USNM 11651).—Pañgapuyan Island, Bavara at the other side of Sitio, 1 fathom sandy, muddy and stony, with eelgrasses; W. R. Taylor, January 1941. A few fragments from the surface of *Valonia* (USNM 11676).

AUSTRALIA: Port Jackson; North Pacific-Exploring Expedition, sta. S.H. 142, collector William Stimpson 1853–56. Several colonies (USNM 11766) growing on *Herdmania momus* var. *grandis* (Heller) (USNM 11767).

PALAU ISLANDS: Barrier reef NW. of Koror Island; GVF sta. 25. Nine colonies (USNM 11379).—Iwayama Bay, between Kaibakku Island (XXIX) and Auluptagel Island; GVF sta. 30. A small mass attached to seaweed (USNM 11458).—Ngemelis Island, seaward reef flat; GVF sta. 61. Two colonies, with gorgonians (USNM 11392).—Iwayama Bay, south end of Island XX; GVF sta. 134. One colony, attached to *Turbinaria* (coral) (USNM 11399).—Iwayama Bay, east side of Oyster Pass; GVF sta. 220. Three small, zooidless colonies (USNM 11443) from surface of *Polycarpa iwayamae* Tokioka (USNM 11412).—Ngerkuid, west of Eil Malk; GVF sta. 261. Six colonies attached to *Halimeda* (alga) (USNM 11397), together with *Didemnum ternatanum* (Gottschaldt) (USNM 11398).

GILBERT ISLANDS: Onotoa Atoll; P. E. Cloud, sta. GOC–35. One colony with sexually immature zooids (USNM 11488) attached to *Polycarpa iwayamae* Tokioka (USNM 11494).

DESCRIPTION.—The specimen from the Gilbert Islands is small, 4 mm. × 3 mm. in extent and 1 mm. in thickness; those from Port Jackson, Australia, are less than 10 mm. × 7 mm. in extent and only 0.5 mm. in thickness; a thin colony from Japanese waters is 3 mm. in diameter and 15 mm. in length, encrusting a small piece of reef coral; from Philippine waters a considerable number of small colonies less than 25 mm. × 13 mm. in extent; about 20 colonies from the Palaus, the largest 35 mm. × 23 mm. in extent, and varies in thickness from 1 to 2 mm., exceptionally up to 5 mm. along the periphery and in some parts of larger colonies. The colonies are encrusted, irregular in shape, and usually white, but may be faintly grayish, yellowish or purplish either all over or in parts of some of the colonies. The colony from GVF sta. 134 in the Palau Islands (USNM 11399) is rather heavily pigmented; dark brownish pigment is deposited in the surface layer of the zooidal stratum, especially densely around the common cloacal aperture (fig. 20*d*). In the colonies from GVF sta. 25, also Palau Islands (USNM 11379), the purplish pigment is concentrated between the zooids and give the colonies a rather finely areolated appearance.

Spicules are usually distributed densely and evenly from the bottom to the surface of the colony, but they may be rather sparse as a whole or above the individual zooids in some colonies; in the latter cases the surface of the colony appears spotted with many small, slightly darker ovals. In some colonies from the Philippine Islands, the test is slightly swollen above the zooids and some minute prominences formed by aggregated spicules are scattered between these swellings; this evidently shows an intermediate state between the typical and next granulated forms. The superficial spiculeless layer is practically indiscernible on some colonies, but rather conspicuous in others. The colonies densely impregnated with spicules but without the distinct superficial spiculeless layer are somewhat rigid in consistency and rather rough to the touch, while those with the thick superficial spiculeless layer generally show a very smooth appearance on the surface. The size of spicules varies considerably, from 17 to 55μ in diameter in the colonies examined. They are 20–24μ in Australian specimens, 28–33μ in a Japanese colony, 17–28μ, 33–39μ, 41–55μ, and exceptionally up to 64μ, in specimens examined from the Palau Islands. In some colonies spicules are slightly larger along the periphery than in the central part of the colony, and in the colonies densely packed with spicules they are slightly smaller than in the colonies with sparcely distributed spicules. Rays of spicules are short and blunt or truncate at the tip in the typical form, although they may be rather slender and with the tip acute or truncate in some colonies; the number of rays on the equatorial plane varies from 6–9 to 11–15. Thoracic lacunae distinct and spacious; hypoabdominal lacuna absent. Even in thicker colonies zooids are situated in the surface layer of less than 1.5 mm. in thickness, while the lower part is a compact mass of spicules and contains fertilized eggs or embryos. The common cloacal apertures are elliptical or roundish in outline, and larger ones may be 3 mm. in long diameter. Usually zooids are missing in the considerably wide area surrounding the cloacal aperture.

There are four small, whitish compact masses of spicules in the material from the Palau Islands from GVF stas. 30 and 220. They are roundish or oval in outline, less than 5 mm. in length and up to 2 mm. in thickness. They contain no zooids within the test. Spicules are distributed evenly from the bottom to the surface, but slightly denser in the lowest part; they are of the typical *moseleyi*-form and with 6–10, most frequently 7–8, rays on the equatorial plane. For this reason, these masses are identified provisionally as *Didemnum moseleyi.*

Thorax 430 to 560μ long in specimens examined. Retractile muscle of moderate length, or attaining 1½ times the length of contracted thorax. Usually a fan-shaped thoracic organ is found near posteroventral corner of the wide atrial aperture on each side. Branchial aperture 6-lobed, artial languet absent. Stigmatal rows 4; about 6 stigmata in each row. One testicular follicle, proximal part of vas deferens coiling 4–7 times. Intestine not curved strongly in zooids with immature gonads.

Trunk 550μ long in a larval specimen examined. Three attachment processes arranged lineally, four pairs of ampullae present.

20a. *Didemnum (Didemnum) moseleyi* forma *granulatum* Tokioka

Figures 20*e,f*

Didemnum (Didemnum) moseleyi f. *granulatum* Tokioka, 1954a, p. 6, pl. 21, figs. 1–4.

MATERIAL EXAMINED

Palau Islands: Barrier reef 8 mi. NW. of Koror Island; GVF sta. 25. Many colonies (USNM 11380).—Iwayama Bay, east side of Oyster Pass; GVF sta. 220. Several colonies (USNM 11412).

Description.—Many small colonies attached to a solitary ascidian (*Polycarpa iwayamae* Tokioka), and to colonies of an alcyonarian coral. The larger specimens examined are 19 mm.×7 mm. or 12 mm.× 10 mm. in extent and 0.5 mm.–1 mm. in thickness; they are whitish in color.

Spicules of moderate size, 22–28μ in diameter in colonies from GVF sta. 220 and 27–31μ in those from sta. 25, and distributed densely and evenly throughout test from bottom to surface; rays are rather slender, 7 to 9 on the equatorial plane. Superficial spiculeless layer indiscernible; small granular prominences formed by aggregated spicules on entire surface of colony, especially densely around branchial apertures and above lacunar systems. Common cloacal apertures sometimes supported by about 20 riblike structures made of spicules, as seen in specimens from GVF sta. 220 of the Palau Islands (fig. 20*e*). Thoracic lacunae distinct and spacious. Zooids rather small; atrial apertures wide; 6 stigmata in each of 4 rows. One testicular follicle, proximal part of vas deferens coiling 5–7 times.

Larvae small, with 4 pairs of ampullae, two pigment flecks of sensory organ arranged anteroposteriorly.

21. *Didemnum (Didemnum) nekozita*, new species

Figure 21

Holotype.—USNM 11381; Palau Islands: barrier reef 8 mi. NW. of Koror Island 7°24′30″ N., 134°21′20″ E. (HO chart 6102, 1st ed.); 3–7 feet, sand, coral heads, and dead coral; GVF sta. 25, July 19, 1955.

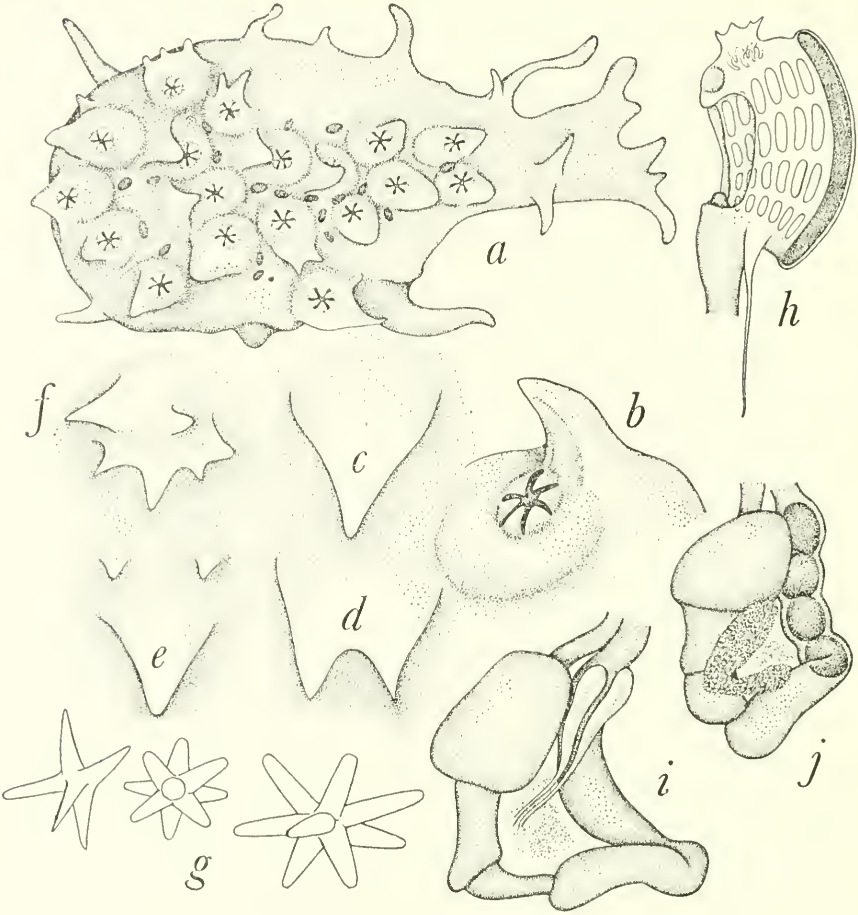

Figure 21.—*Didemnum* (*Didemnum*) *nekozita*, new species: *a*, 4 mm. colony from the Palau Islands, sta. 25; *b–f*, variously shaped prominences on surface of colonies from same locality; *g*, spicules from colonies from same locality; *h*, right side of thorax from colony from Palau Islands, sta. 35; *i*, right side of abdomen from colony from Palau Islands, sta. 25; *j*, right side of abdomen from colony from Palau Islands, sta. 35.

Paratypes.—USNM 11801, same data as holotype, 34+ specimens.—USNM 11418, Palau Islands: Peleliu boat channel between Ngargersal and Kongauru Islands, approximately 1 mi. E. of north tip of Peleliu; 7°02′51″ N., 134°17′42″ E. (HO chart 4007); 1–10 feet, sand, silt, and occasional coral, with *Enhalus acoroides* and 2 other ssp. of eelgrasses, and many algae including *Caulerpa;* GVF sta. 35, July 24, 1955, many specimens (USNM 11418).

Additional Specimens.—Palau Islands: Iwayama Bay, mouth of Oyster Pass, between Island XXIX and east end of Koror; GVF sta. 236A, four specimens (USNM 11423).

PHILIPPINE ISLANDS: Baliwasan; W. R. Taylor, sta. 10, eight small colonies (USNM 11798).

DESCRIPTION.—Many small colonies from the Palau Islands and several small ones from the Philippines. Larger colonies are 8 mm. ×7 mm., 10 mm.×5 mm., and 14 mm.×4 mm. in extent and 1 mm. in thickness. They are attached to the surface of alcyonarian colonies, the basal portion of colonies of a compound ascidian *Synclavella* sp., the leaves of *Enhalus acoroides* (L.f) Steud, and other plants.

Color, usually whitish, though slightly grayish or yellowish in some colonies, due to existence of many calcareous spicules in test. Generally a single common cloacal aperture opens near center of colony. Test slightly swollen above individual zooids, many small prominences of various shapes (fig. 21*b–f*) scattered on surface; one is situated at ventral side of branchial aperture of each zooid, i.e., the side facing periphery of colony (fig 21*a*). Some fecal pellets found embedded under thin superficial spiculeless layer between zooids. No system found in arrangement of zooids. Thoracic lacunae well developed, hypoabdominal lacunae absent.

Spicules rather small, 22–27μ in diameter in measured examples, about 24μ on the average. In most colonies spicules distributed rather densely and evenly throughout test from bottom to surface. Spicules somewhat sparse in the four colonies found attached to the colony of *Synclavella* collected on the Palau Islands; in such colonies consistency of test is rather soft as compared with those densely packed with spicules. Spicules may be nearly of the typical *moseleyi*-form in some colonies, with rays blunt at the tip and 5 to 8 in number on the equatorial plane; in addition, a small number of spicules consisting of very short and bluntly tipped rays. In many other colonies, however, spicules consist of considerably fewer (8 to 10) and more slender rays, each ending in a blunt tip; thus there are only 4 to 8, most frequently 5 to 6, rays on the equatorial plane; also a few giant spicules consisting of about 5 rays.

Zooids mostly sexually immature. Branchial aperture 6-lobed, atrial languet absent. Retractile muscle of moderate length, often reaching 1½ times the length of contracted thorax. Four stigmatal rows and six to seven stigmata in each row; dorsal languets distinct. Tentacles about 12, of which the dorsal is longest. Other structures of thorax and abdomen quite the same as those of *Didemnum* (*Didemnum*) *moseleyi* (Herdman). In some zooids there are a couple of remarkable club-shaped circumintestinal glands on right side of intestinal loop at level of stomach (fig. 21*i*); in some others a certain reddish brown glandular tissue is found also on right side of intestinal loop (fig. 21*j*). One testicular follicle, rarely two; proximal portion of vas deferens coiling about five times.

Larva very large, about 700μ in length. Pigment flecks of sensory organ arranged anteroposteriorly. Its structure resembles that of *Didemnum* (*Didemnum*) *moseleyi* (Herdman).

Remarks.—The appearance of the colony surface is unique. *Didemnum* (*Didemnum*) *apersum* Tokioka, 1953, also has many finger-shaped protuberances on the test surface, but the shape and the disposition of these prominences differ distinctly; moreover the shape of the predominant spicules does not conform with those of the present new species. The spicules of *Leptoclinum tonga* Herdman, 1886, *Didemnum* (*Leptoclinum*) *fuscum* Sluiter, 1909, and *Didemnum* (*Leptoclinum*) *spongioides* Sluiter, 1909, closely resemble those of the present species, but none of the characteristic prominences are found on the colony surface in the older species. As colonies showing quite the same appearance were found rather abundantly at different stations in the Palau Islands and even in Philippine waters fairly distant from the Caroline Islands, it seems more reasonable to treat the present specimens as belonging to a distinct new species rather than to include them in any previously known species.

The specific name *nekozita* is derived from the Japanese *neko*=cat and *sita* (*zita* in combination)=tongue, in allusion to the prominences on the surface of the test, which resemble a cat's tongue.

22. *Didemnum (Didemnum) sphaericum*, new species

Figures 22*a,b*

Holotype.—USNM 11431; Palau Islands: fringing reef of small island in western part of Eil Malk lagoon of (Meharehar); 7°10′01″ N., 134°21′50″ E. (HO chart 6078, 1st ed.), 0–10 feet on limestone shelf, with coral and sand, GVF sta. 252, October 27, 1955.

Paratypes.—USNM 11809, same data, many specimens.

Description.—Many small, roughly spherical colonies crowded on the branches of an alga of Corallinaceae collected on the Palau Islands. The largest one measured 6 mm. in long diameter; but the thickness is very difficult to measure accurately because the colonies are attached to the thin branches of the alga in a spherical form. Very probably they are less than 1 mm. in thickness.

Test soft and whitish as a whole, rather sparsely impregnated with calcareous spicules so that pale reddish-brown zooids are seen through test. Zooids distributed nearly evenly throughout test. Spicules small, 15–30μ in diameter in those measured, 21μ on an average; rays of moderate length, ending bluntly at the tip; 6 to 8 rays on the equatorial plane. Superficial spiculeless layer thin, containing some faded pigment cells. Probably the living animal was colored pinkish. Thoracic lacunae well developed. Branchial aperture 6-lobed, retractile muscle of moderate length, 4 stigmatal rows present. Abdomen very small, 300–380μ in length, and less than 560μ even when meas-

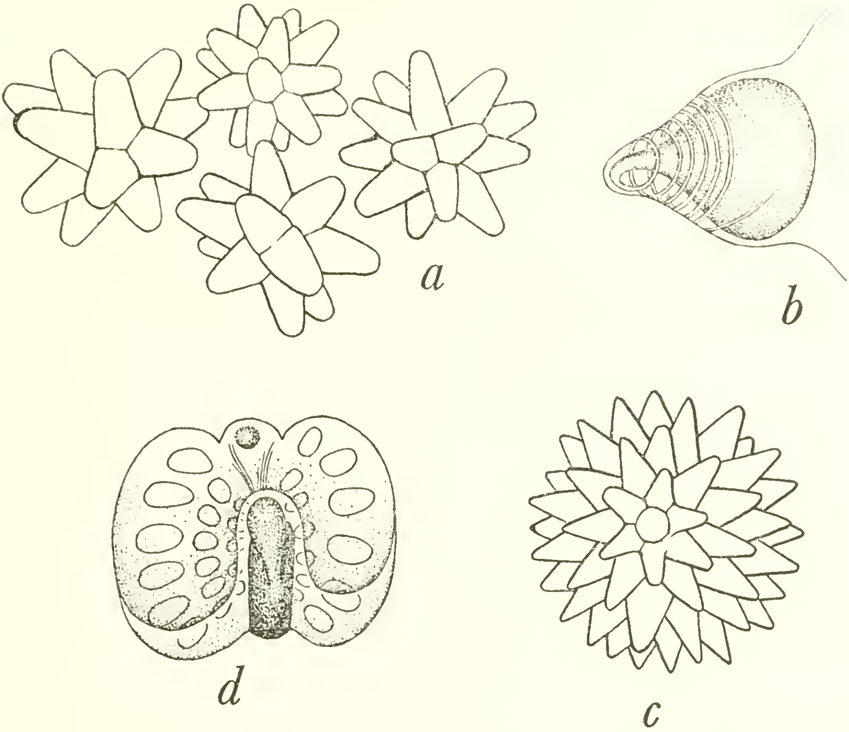

Figure 22.—*a, b, Didemnum* (*Didemnum*) *sphaericum,* new species: *a,* spicules, × 940; *b,* testicular follicle. *c, d, Didemnum* (*?Didemnum*) *macrospiculatum,* new species: *c,* spicule, × 425; *d,* strongly contracted thorax, posterior side.

ured together with mature testis; one testicular follicle, the distal portion of which is remarkably narrowed to give the organ a bulblike shape; proximal portion of vas deferens coils about six times.

Remarks.—The soft consistency of the test and the bulb-shaped testicular follicle are the best characteristics of the present form, differentiating it from any known species. In *Didemnum* (*Didemnum*) *dorotubu* the testicular follicles are also sometimes bulb-shaped, but the appearance of the test differs considerably from that of the present new species.

23. *Didemnum* (*?Didemnum*) *macrospiculatum*, new species

Figures 22*c,d*

Holotype.—USNM 11489; Gilbert Islands: Onotoa Atoll, about 13,400 feet S. 75° W. from Aiaka Maneaba, in the deep central part of the lagoon; living and dead coral patches on limesand and limemud bottom. Preston E. Cloud, sta. GOC–55, August 25, 1951.

Paratype.—USNM 11808: same data.

Description.—Two colonies are in the material, respectively, 30 mm. × 10 mm. and 12 mm. × 7 mm. in extent and about 1 mm. in thickness.

Colonies pale grayish brown, although many calcareous spicules present in test. Spicules very large, 77–110μ in diameter, 87μ on an average, somewhat transparent, confined to only the surface and bottom layers, leaving the layer containing zooids quite free from spicules. Rays of spicules short, acutely pointed at tip, rather numerous, from 13 to 19 on the equatorial plane. Zooidal layer reddish brown, possibly stained by dark pigments of *Polycarpa cryptocarpa* (Sluiter) which was preserved in the same bottle with the present specimens; somewhat fibrous in consistency and very tough. All thoraces so strongly contracted that it is quite impossible to measure the length accurately. Atrial aperture a wide opening; 4 rows of stigmata present, about 6 stigmata in each row. Abdomens very small (290μ in an examined specimen) and embedded in the spiculeless zooidal layer. No gonads found in any zooids examined.

REMARKS.—The extraordinary size of spicules is characteristic of the present new species. As the thoraces are strongly contracted and the abdomens are devoid of any well-defined gonad, it is impossible to clarify the subgeneric situation of this new species, although it probably belongs to the subgenus *Didemnum* as is seen in figure 22*d*.

24. *Didemnum (Didemnum) siphonale*, new species

FIGURE 23

HOLOTYPE.—USNM 11804; Japan: Honshu Island, off Manazuru Zaki N.8°W., 4.5 miles, 153 fathoms, green mud, volcanic ash and sand; *Albatross* sta. 3698, May 5, 1900.

PARATYPES.—USNM 11805: same data, 7 specimens.

DESCRIPTION.—Eight colonies are in the material; the largest (holotype) is 15 mm. × 10 mm. in extent and 1.5–2 mm. in thickness. They are all whitish in color and encrusting the surface of a specimen of *Herdmania momus* (Savigny). Usually a single large and oval common cloacal aperture, up to 1 mm. in long diameter, is found near the center of respective colonies; it is always opened at the tip of a short siphon, the inner surface of which is folded as shown in figure 23a. The whole colony surface shows a kind of cerebral appearance, for it is divided into a number of low elevations each covering one to three zooids. In the grooves between these elevations are found sparsely scattered minute prominences formed by the aggregation of calcareous spicules; they may grow up to small finger-shaped protuberances in some colonies (fig. 23*b*) or may be quite absent in some others. Spicules small, distributed densely and evenly throughout test from bottom to surface; superficial spiculeless layer extremely thin. Spicules are only 12–18μ in diameter, 14μ on an average; rays short, bluntly tipped and 7–9 on the equatorial plane. Lacunae system very spacious, extending not only in thoracic layer but also to

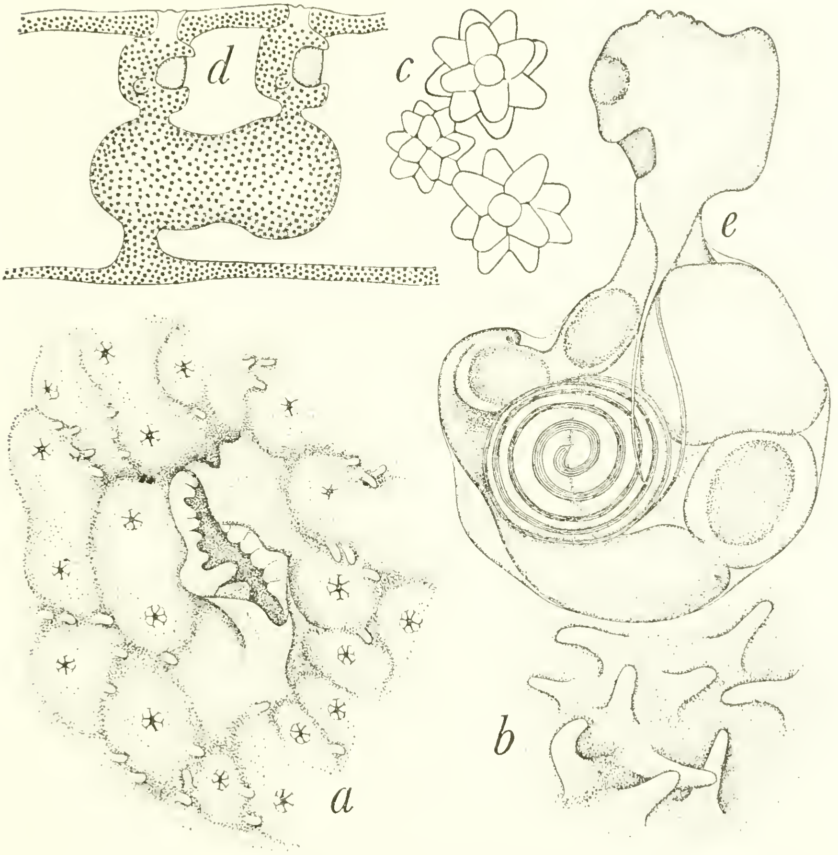

FIGURE 23.—*Didemnum* (*Didemnum*) *siphonale*, new species: *a*, central part of colony showing common cloacal aperture; *b*, finger-shaped prominences on surface of some colonies; *c*, spicules, × 1800; *d*, schema showing the section of colony; *e*, right side of a zooid, × 100.

abdominal layer; thus abdomens of one to a few zooids are almost entirely surrounded by lacunae, as in species of the genus *Leptoclinum* (fig. 23*d*).

Zooids large; thorax about 450μ in a strongly contracted state, abdomen about 700μ in length. Retractile muscle of moderate length. A small roundish thoracic organ is found near posteroventral corner of the widely opened atrial aperture on each side. About 10 (?) longitudinal muscles on each side of thorax. Branchial aperture 6-lobed, stigmatal rows 4, about 8 stigmata in each row. Two testicular follicles, proximal portion of vas deferens coils 6–7 times.

REMARKS.—The existence of finger-shaped prominences on the surface of some colonies, small spicules and large zooids reminds us of *Didemnum* (*Didemnum*) *apersum* Tokioka, 1953, from Sagami Bay.

The spicules of *D.* (*D.*) *apersum* are, however, a little larger (16–25μ) than those of the present new species, although the shape of these two species is quite similar. Moreover, the existence of the short common cloacal siphon and the lacunae system extraordinarily developed in the present new species is quite unique; and the species is named for the first of these characteristics.

25. *Didemnum (Didemnum) dorotubu*, new name

FIGURE 24*a*

Hypurgon fuscum Oka, 1931c, p. 287, fig. 1.
Didemnum (*Didemnum*) *fuscum* Tokioka, 1953a, p. 192, pl. 12, figs. 1–10.
Non *Didemnum fuscum* Sluiter, 1909, p. 52.

MATERIAL EXAMINED

CHINA: Probably vicinity of Amoy, T. Y. Chen, Univ. of Amoy, sta. 2, no other data available; received October 12, 1932. One fragment (USNM 11534), from surface of solitary ascidian *Microcosmus exasperatus* (Heller) (USNM 11528).

PHILIPPINE ISLANDS: Small Sibago Island; W. R. Taylor, sta. 7. One colony encrusting an alcyonarian coral (USNM 11667).—Baliwasan; W. R. Taylor, sta. 10. Eight colonies encrusting an alcyonarian coral (USNM 11657); many colonies (USNM 11656).

DESCRIPTION.—Examined were a single encrusted colony, 15 mm. × 15 mm. in extent and 1.5 mm. in thickness, from Amoy, China, and many colonies encrusting the alcyonarian colonies or leaves of *Halimeda* from the Philippine waters, the largest one of the latter is 24 mm. × 17 mm. in extent and 1–2 mm. in thickness.

Test translucent, devoid of spicules (Chinese specimen) or containing spicules somewhat densely around the branchial apertures but extremely sparsely in other parts of the colony (Philippine specimens). Test packed very densely with fecal pellets, except the area around the branchial aperture above respective zooids, thus the whole colony is colored with a mudlike yellowish-brown tint. Spicules small, 20–25μ in diameter, of the *candidum*-type, and with very many fine rays. Some of spicules found in a dissolving state. Atrial aperture of zooids wide, four stigmatal rows, one testicular follicle, proximal part of vas deferens coils more than five times.

Structure of larva resembles closely that of *Didemnum* (*Didemnum*) *moseleyi* (Herdman). Trunk is 380–400μ in length, with four pairs of ampullae; two pigment flecks of sensory organ arranged anteroposteriorly.

REMARKS.—The specific name *fuscum* in the genus *Didemnum* is preoccupied by Sluiter for *Didemnum fuscum*, new species (1909, *Siboga*-Exped., Monogr. 56b, p. 52). As there is no reference to the existence of the atrial languet in Sluiter's descriptions, his species seems to belong to the subgenus *Didemnum*. Consequently the specific name of *Hypurgon fuscum* cannot be retained when this species is cleared to belong to *Didemnum* (*Didemnum*), thus, it is replaced by *dorotubu*, new name (*doro*=muddy and *tubu*=pellet in Japanese). It is very possible that the present species is identical with *Hypurgon skeati* Sollas from the Malay Peninsula, but at present I have not yet studied enough specimens from various localities to ascertain this identity.

26. *Didemnum (Didemnum) misakiense* (Oka & Willey)

FIGURES 24*b–e*

Sarcodidemnoides misakiense Oka & Willey, 1892, p. 313, pls. 17–18.
Didemnum (*Didemnum*) *misakiense* Tokioka, 1955c, p. 23.

MATERIAL EXAMINED

JAPAN: Off Omai Zaki Light, Honshu; *Albatross* sta. 3727. One colony (USNM 11777).

PHILIPPINE ISLANDS: Off Jolo Light; *Albatross* sta. 5174. One colony (USNM 11749), attached to gorgonian coral of the genus *Echinogorgia* (USNM 52052).

DESCRIPTION.—Two colonies are in the material. The colony from the Philippine Islands is attached to the middle of a large *Echinogorgia* (cat. no. 52052), 3.5 mm. in diameter and 250 mm. in length, and it consists of about a dozen mammillary prominences, 70 mm. × 65 mm. × 30 mm. in extent and pale grayish yellow in color; the largest mammillary process is 23 mm. × 5 mm. in extent and 31 mm. in thickness. The colony from Japan is 35 mm. × 25 mm. in extent, pale yellowish brown and consists of only three irregularly shaped mammillary processes.

Axial core of test is soft, gelatinous, translucent, somewhat paler in color and much less densely impregnated with spicules than the surface layer. Zooids arranged in a single layer, forming the thin zooidal stratum enclosing the axial core. Spicules and also pigment cells found most densely in outer layer of this zooidal stratum. Superficial spiculeless layer extremely thin, consequently some parts of colonies are rather rough to the touch. Well-defined hypozooidal lacunae developed between zooidal stratum and axial core. Spicules very small in Japanese specimen and of the *moseleyi*-type, but only 13–18μ in diameter and with 8–9 rays on the equatorial plane. Spicules somewhat larger in Philippines specimen, 24–33μ in diameter and with 9–13 (about 12 on an average) rays on the equatorial plane. Usually a single roundish common cloacal aperture situated near summit of each mammillary process, although one or two more common cloacal apertures may be seen on some large mammillary processes. Atrial aperture very wide, with a kind of very short and bifid atrial languet (?) (figs. 24*d,e*) in the Philippine specimen. Stigmatal rows four, one testicular follicle, proximal part of vas deferens coils six to eight times.

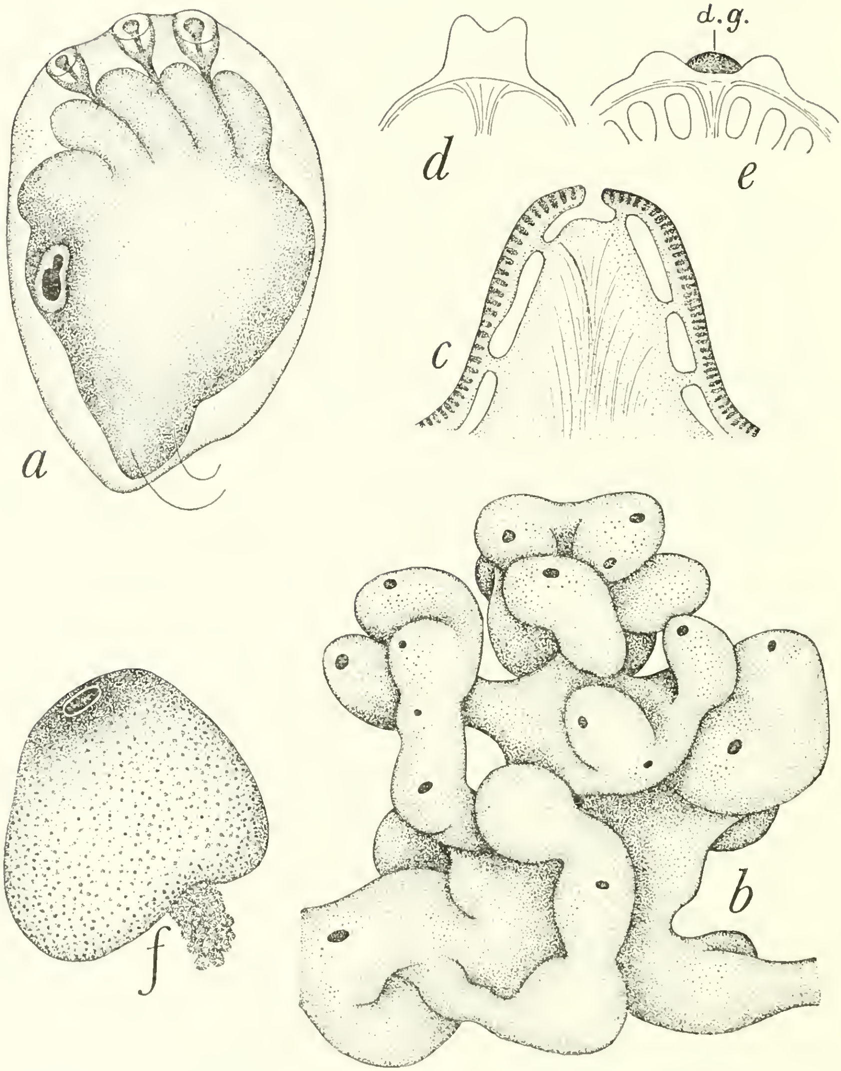

Figure 24.—*a*, *Didemnum* (*Didemnum*) *dorotubu*, new name: right side of larva from a Philippine colony. *b–e*, *Didemnum* (*Didemnum*) *misakiense* (Oka & Willey): *b*, colony from Philippine Islands, × 1.5; *c*, schema showing longitudinal section of mammillary process of same; *d*, *e*, very short and bifid atrial languet (?) of zooids of same colony, posterior side (d.g.=dorsal ganglion). *f*, *Didemnum* (*Didemnum*) *ternatanum* (Gottschaldt): the 41 mm. wide colony from Palau Islands, sta. 67.

27. *Didemnum (Didemnum) ternatanum* (Gottschaldt)

FIGURE 24*f*

Didemnoides ternatanum Gottschaldt, 1898, p. 648, pl. 35, fig. 1.
Didemnum ternatanum Van Name, 1918, p. 152, figs. 104–106.
Didemnum (*Didemnum*) *ternatanum* Tokioka, 1955b, p. 47, pl. 3, figs. 18–29.

MATERIAL EXAMINED

PHILIPPINE ISLANDS: Basilan Island; Tundun Pasil, near lighthouse at Isabela channel, 1 fathom; W. R. Taylor, coll., January 1941. One specimen 3.4 × 2.5 mm. in extent and 2 mm. thick, with 52 branchial apertures on the surface (USNM 11686).—Basilan Island; Punta Natangol, W. R. Taylor, sta. 31, one small, elongated colony 2 × 8 mm. in extent (USNM 11666).

PALAU ISLANDS: West end of Koror Island, GVF sta. 12; 4 colonies (USNM 11400).—West end of Koror Island, GVF sta. 16; 13 colonies (USNM 11404).—Southern end of Urukthapel Island, GVF sta. 67; 1 colony (USNM 11420).—Iwayama Bay, mouth of Oyster Pass, GVF sta. 236A; many colonies (USNM 11427).—Ngerkuid, west of Eil Malk, GVF sta. 261; 12 colonies (USNM 11398).

DESCRIPTION.—Many colonies from the Palau Islands and three small pieces from the Philippine Islands were examined. They were attached to fragments of reef corals, eelgrasses, *Halimeda*, and algae of Corallinaceae. They are roughly conical, hemispherical, or even spherical in some small colonies, the largest is 41 mm. at the widest part and 38 mm. in height (USNM 11420, the Palau Islands). Common cloacal aperture opens at apex of colony and may reach 4 mm. in long diameter. Axial core very soft and zooids are arranged in a thin surface layer, consequently the colony is somewhat soft in consistency. Preserved specimens are whitish, light brownish, reddish brown, dark grayish, or blackish; usually most dark pigmented in distal part of colony surrounding common cloacal aperture, but basal half is whitish, grayish white or rather translucent. Common cloacal aperture and (in many cases) branchial apertures are also fringed densely with white spicules. On some colonies, spicules rather sparse, especially in basal portion; in such specimens, when alive, greenish tint of zoochlorellae contained in lacunae system is seen through the test (the preservative is usually colored green by dissolving the chlorophyll of zoochlorellae). Spicules small, of *candidum*-type; usually 16–20μ in diameter, may be only 10–15μ in some colonies, but exceptionally up to 20–33μ in a specimen from the Philippines (USNM 11666). Rays short and very numerous. Branchial apertures 6-lobed, stigmatal rows four. One testicular follicle, proximal part of vas deferens coils 5½ to 6 times. Situation of respective parts of the alimentary canal quite the same as in common species of the genus *Didemnum*.

REMARKS.—Small colonies of this species closely resemble those of *Lissoclinum pulvinum* (Tokioka) which also contains zoochlorellae in the lacuna system. However, the spicules are distinctly of the *candi-*

dum-type in the present species and somewhat smaller than in *Lissoclinum pulvinum*, and the consistency of the test seems more fragile in *D. ternatanum* than in *L. pulvinum.*

28. *Didemnum (Polysyncraton) sagamiana* Tokioka

FIGURES 25*a,b*

Didemnum (*Polysyncraton*) *sagamiana* Tokioka, 1953a, p. 196, pl. 21, figs. 1–3.

MATERIAL EXAMINED

PALAU ISLANDS: USNM Accession 206221, sta. 25–865, three colonies.

DESCRIPTION.—Of the three colonies examined the largest is 5 mm. × 3 mm. in extent and 1 mm. in thickness. Faintly grayish white, darker in nuance where zooids are embedded. Spicules distributed densely and evenly throughout test, superficial spiculeless layer distinct, although not remarkable. Spicules rather small, 16–32μ in diameter and 22μ on an average, *candidum*-type; rays numerous, very short and bluntly tipped.

Zooids rather large; abdomen about 620μ in length. Branchial aperture 6-lobed, atrial aperture wide and with bifid atrial languet; retractile muscle distinct. Testicular follicles 5–7 in zooids examined; proximal part of vas deferens coils 1½ to 2½ times. Intestinal loop not curved as sharply as in subgenus *Didemnum.*

Larval test frothy; two pigment flecks of sensory organ arranged anteroposteriorly. Number of ampullae cannot be given clearly, as all examined embryos were not fully developed.

29. *Didemnum (Polysyncraton) semifuscum* (Sluiter)

FIGURES 25*c–f*

Didemnum semifuscum Sluiter, 1909, p. 62, pl. 3, figs. 28–30.

MATERIAL EXAMINED

GILBERT ISLANDS: Collected August 25, 1951; 11 small colonies (USNM 11486, 11490).

DESCRIPTION.—Eleven small whitish colonies from the Gilbert Islands were examined, the largest is 6 mm. × 4 mm. in extent and 1 mm. in thickness. A single common cloacal aperture located near the center of respective colonies and fringed with 5 or 6 lobules, as shown in figure 25*c*. Spicules 31–47μ in diameter, 39μ on an average, *candidum*-type (fig. 25*d*) consisting of many short, acutely pointed rays, or nearly spherical in shape with a number of small conical prominences on surface (fig. 25*e*), which are 15–20 (about 18 on an average) on the equatorial plane. Spicules distributed very densely and evenly throughout test from surface to bottom. Zooids stained dark grayish;

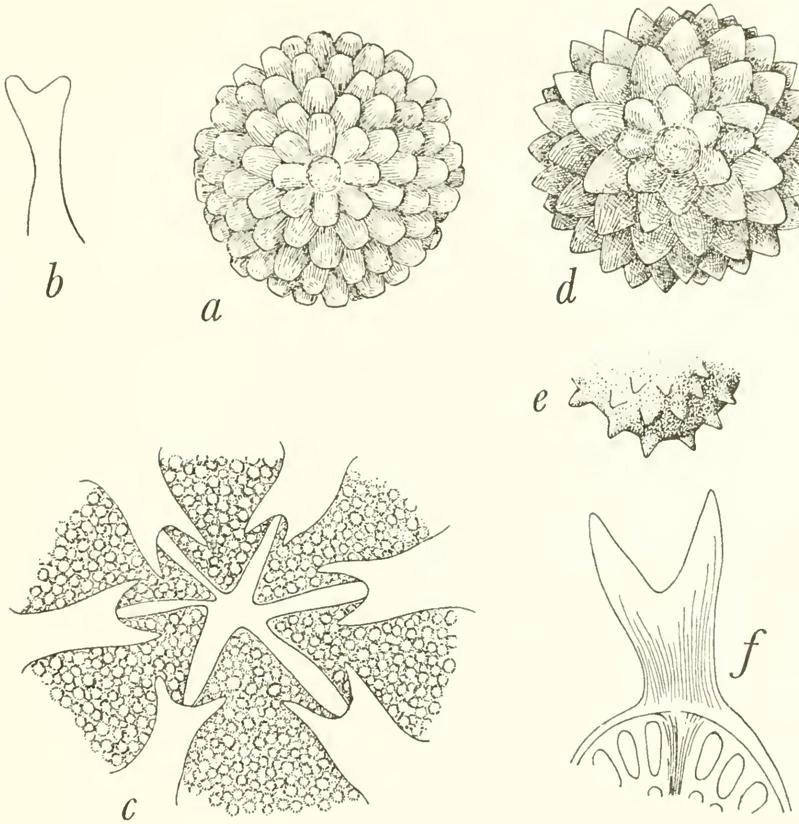

Figure 25.—*a*, *b*, *Didemnum* (*Polysyncraton*) *sagamiana* Tokioka: *a*, spicule, × 1800; *b*, atrial languet. *c–f*, *Didemnum* (*Polysyncraton*) *semifuscum* (Sluiter): *c*, common cloacal aperture; *d*, spicule, × 940; *e*, part of spicule from another colony; *f*, atrial languet, posterior side.

abdomen 420–450μ in length. Atrial languet very large and bifurcated. Intestine not strongly curved.

Remarks.—Zooids having a very stout atrial languet and the existence in some colonies of spherical spicules, up to about 50μ in diameter, seem to be sufficient reasons to put the present specimens under *Didemnum* (*P.*) *semifuscum*, although the common cloacal aperture is not described on Sluiter's specimens. It is not impossible that *D.* (*P.*) *sagamiana* is included in this species, as the spicules of the former can be regarded as being in a dissolving phase of those of the latter. However, the difference found in size and appearance of the spicules is notable and the existence of the characteristic common cloacal aperture in the present species is unique. It might be better, at present, to retain *D.* (*P.*) *sagamiana* as a distinct species until some intermediate forms connecting the two species are found.

30. *Trididemnum savignii* (Herdman)

FIGURE 26

Didemnum savignii Herdman, 1886, p. 261, pl. 34, figs. 1–5.

?*Didemnum areolatum* Herdman, 1906, p. 337, pl. 8, figs. 26–27.

Trididemnum savignii Hastings, 1931, p. 91.—Van Name, 1945, p. 100, fig. 45; pl. 18, fig. 4.—Tokioka, 1953a, p. 197, pl. 21, figs. 4–8.

MATERIAL EXAMINED

JAPAN: Honshu, off Noma Saki S.86°E, 5.7 mi.; *Albatross* sta. 3725. Two colonies (USNM 11772).

PHILIPPINE ISLANDS: Off Jolo Light east 2.6 miles; *Albatross* sta. 5174. One colony (USNM 11733) from the surface of *Stolonica styeliformis* Van Name (USNM 11634) which was attached to gorgonian coral, *Echinogorgia* sp. (USNM 52052).

PALAU ISLANDS: Barrier reef 8 mi. NW. of Koror Island; GVF sta. 25. Six colonies (USNM 11388).—Fringing reef of small island in lagoon of Eil Malk; GVF sta. 252. About 10 small, nearly spherical colonies (USNM 11429).

MARIANAS ISLANDS: Saipan; P. E. Cloud, sta. D–8. One small colony (USNM 11468) from the basal part of *Eudistoma angolanum* (Michaelsen) (USNM 11504).

HAWAIIAN ISLANDS: Off Mokuhooniki Islet between Maui and Lanai; *Albatross* sta. 3872. One small, elliptical mass (USNM 11779).

DESCRIPTION.—One small colony each from the Philippines, the Hawaiian Islands, and Saipan Island, as well as 2 colonies from Japan and 16 small pieces from the Palau Islands were examined. Among these colonies, only the Japanese specimens are large and massive, 35–45 mm.×30 mm. in extent and 20–30 mm. in height and each consists of several mammillary processes (fig. 26). A roundish common cloacal aperture opens at the distal end of each process, the spacious hypoabdominal lacunae are well developed at thickened portions of the colonies and the axial portion of the colony beneath these lacunae is occupied by well-defined core matrix. The distal parts of mammillary processes are red, other parts are grayish yellow brown. As the preservative is dark yellow, the whole colonies might have been reddish orange when alive. Other small colonies from various localities vary considerably in color, from white or faint milky white to brown. Test soft, gelatinous, translucent, or quite transparent in the colonies which are rather sparsely impregnated with spicules. Superficial spiculeless layer distinct, not thick. Hypozooidal lacunae well defined, but never harbor zoochlorellae within. Spicules comparatively large in colony from Hawaiian Islands (31–40μ in diameter), and in colony from the Philippine Islands (45–60μ), but rather small in the two Japanese colonies (23–26μ in diameter). Some crystalline needles are embedded. Colony from Saipan Island has spicules which seem to be in a somewhat degenerate state, being composed of a number of thin needlelike rays projecting from the central spherical bodies. In a perfectly preserved state, spicules are of *moseleyi*-type and consist of rays short, or of moderate length, both bluntly tipped. Number

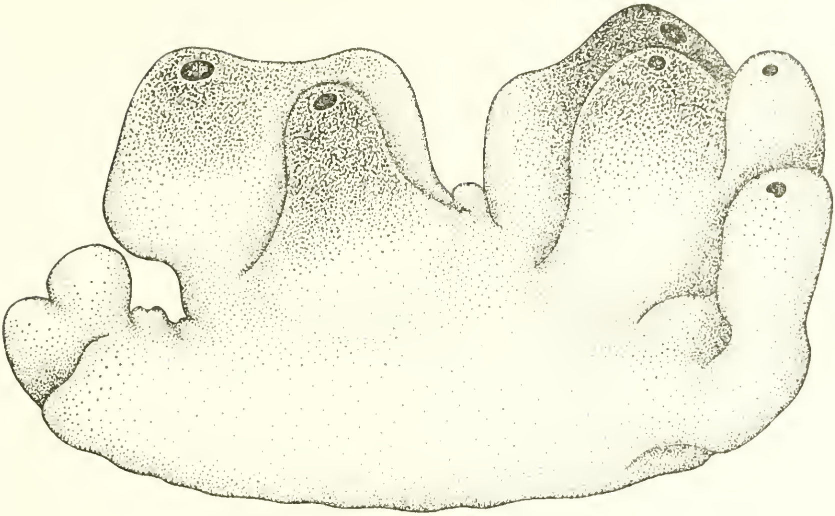

FIGURE 26.—*Trididemnum savignii* (Herdman): Colony collected off Nomasaki, Japan.

of rays on equatorial plane varies from 6 to 8 in Japanese specimens to 10–15 (about 13 on an average) in the Hawaiian specimen, although generally fluctuating between 8 and 12. Density of spicules differs considerably according to colonies, generally speaking they are not particularly dense in any colonies of the present material. They are evenly distributed throughout the test from the bottom to the surface in most colonies, while in two Japanese specimens they are found more densely around respective branchial apertures so that the apertures are seen as white spots to the naked eye.

Size of zooid differs according to colonies; zooids rather small in some colonies, larger in others; thoraces may attain 550μ in a contracted state, abdomens up to 750μ in length; thus distance between zooids becomes relatively large. Zooids colorless, yellowish white or pigmented dark greenish along the peripharyngeal band in some colonies. Branchial aperture 6-lobed, tip of atrial siphon also 6-lobed in some zooids. About 8 longitudinal muscles and a roundish thoracic organ containing minute spicules at level of second transverse vessel on each side of the thorax. Stigmata, 8–10 in each of three rows. One testicular follicle, sometimes bulb-shaped; proximal part of vas deferens usually coils 4 to 6 times or more (8 or 9) in Japanese specimens.

REMARKS.—Two Japanese specimens resemble very closely *Didemnum* (*Didemnum*) *misakiense* (Oka & Willey) in the appearance of the colony and probably in color when they are alive. However, the structure of zooids differs distinctly from that of *D. misakiense*, and is of the typical *Trididemnum*, having three rows of stigmata and the atrial aperture opening near the dorsoposterior corner of the thorax.

31. *Trididemnum savignii* var. *jolense* (Van Name)

FIGURE 27

Didemnopsis jolense Van Name, 1918, p. 147, fig. 97.

MATERIAL EXAMINED

PHILIPPINE ISLANDS: Balukbuluk Island; W. R. Taylor, sta. 40. One small colony (USNM 11636).

PALAU ISLANDS: Iwayama Bay, Geruherugairu Pass; GVF sta. 85. One small colony attached to delicate coralline algae (USNM 11450).—NE. of Cape Ngabadangel ("Gabadaguru"); GVF sta. 125. One small colony (USNM 11438).—SE. end of Koror at eastern entrance to Iwayama Bay; GVF sta. 136. Three small colonies (USNM 11463).

GILBERT ISLANDS: Onotoa Atoll; P. E. Cloud, sta. GOC–41. Nine colonies (USNM 11481).—P. E. Cloud sta. GOC–55. Seven colonies (USNM 11491).—*Heliopora* flat, depth 2 ft., collector A. H. Banner, August 1, 1951. Ten colonies (USNM 11497).

ATLANTIC OCEAN: Gulf of Mexico, off Englewood, Florida, 27°1.7′ N., 82°40.1′ W.; Robert Stewart, sta. B–47=D–9, January 3, 1952. One colony (USNM 11770).

DESCRIPTION.—Examined were 26 colonies from the Gilbert Islands, 5 from the Palau Islands and a single specimen from the Philippine Islands. All the colonies are rather small and somewhat globular or roundish in shape, even the largest is only 20 mm. × 15 mm. in extent, and the height or the thickness of colonies is 3.5–4 mm. in smaller specimens, but up to 6–9 mm. in larger ones. They are dark brownish or dark purplish brown, except the single small specimen from the Palau Islands (USNM 11438). This is regarded as being in a degenerating state, as its test is yellowish white, fairly fragile in consistency and contains many minute whitish particles within; if these particles represent degenerated spicules, then the present specimen should be treated under the typical form of *Trididemnum savignii*.

Test gelatinous, faintly milky white, translucent, usually soft or a little harder to the touch and somewhat frothy in consistency. Many dark brownish, purplish-brown or purplish-black pigments deposited between bladder cells (fig. 27*b*); pigment cells very elongate. Many granular cells and small spherical cells scattered in test, but zoochlorellae never found in lacunae system or embedded in test. In some specimens (for example, specimens from Palau Islands USNM 11463), pigmentation is confined only to the thoracic layer of the zooidal stratum. Some colonies contain small amounts of fecal pellets, fine sand grains and minute crystalline needles in the test; amounts varying considerably among specimens. Crystalline needles usually found most densely in surface layer, especially above lacunae system or in whitish spots of various shapes and sizes at several portions of respective colonies. No perfect calcareous spicules found in test. Surface

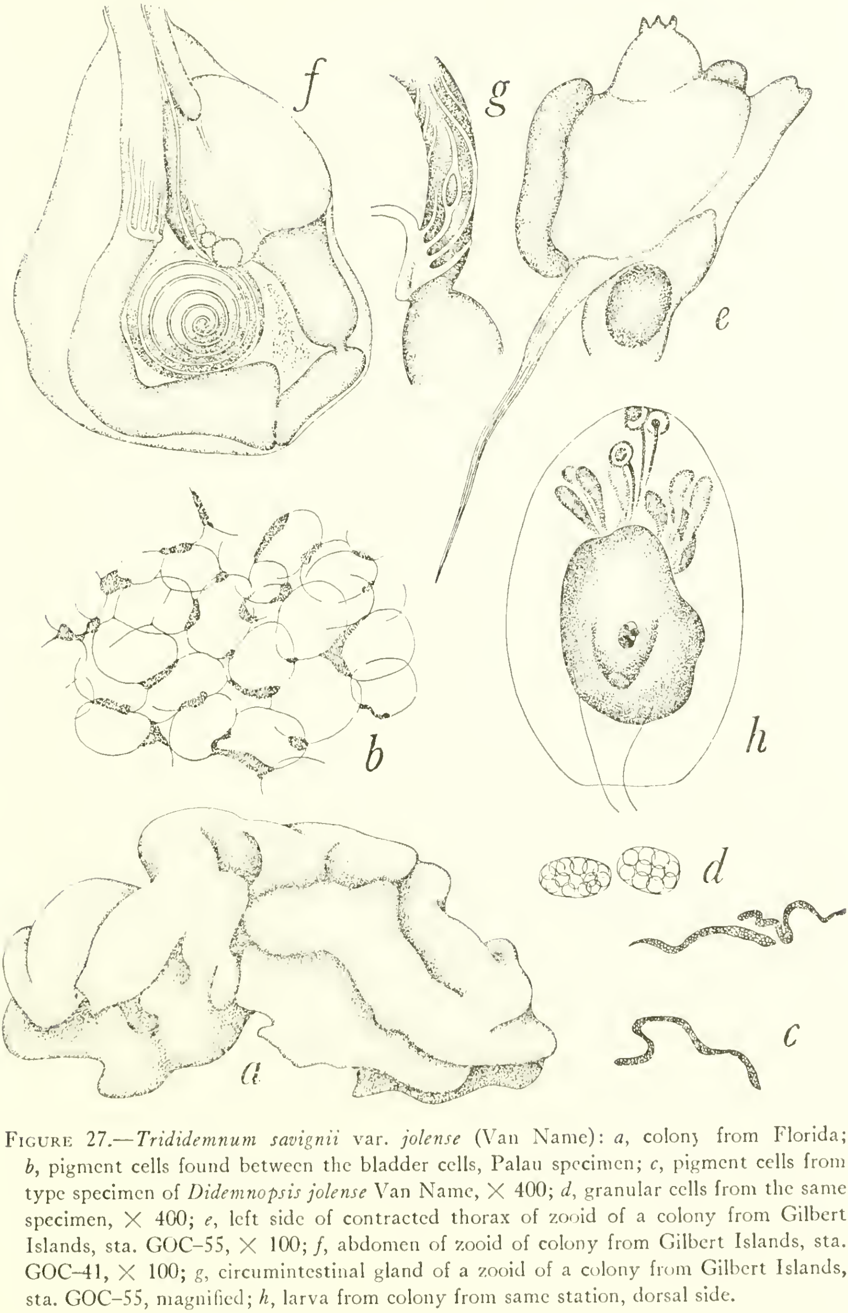

FIGURE 27.—*Trididemnum savignii* var. *jolense* (Van Name): *a*, colony from Florida; *b*, pigment cells found between the bladder cells, Palau specimen; *c*, pigment cells from type specimen of *Didemnopsis jolense* Van Name, × 400; *d*, granular cells from the same specimen, × 400; *e*, left side of contracted thorax of zooid of a colony from Gilbert Islands, sta. GOC–55, × 100; *f*, abdomen of zooid of colony from Gilbert Islands, sta. GOC–41, × 100; *g*, circumintestinal gland of a zooid of a colony from Gilbert Islands, sta. GOC–55, magnified; *h*, larva from colony from same station, dorsal side.

of colony nearly smooth, although depressed irregularly at some places where a number of minute whitish granules are seen in some specimens. Some colonies may carry fine sand grains on surface. Lacunae in some colonies sometimes full of eggs of a parasitic harpacticoid copepod.

A large colony from Florida was carried on the back of a Dromid crab (USNM 11770, 33 mm. in carapace length), 80 mm. × 50 mm. in extent, 40 mm. in height and irregularly lobate as shown in figure 27*a*. Test somewhat hard, gelatinous, translucent, and grayish yellow, surface smooth and quite free from any foreign matter, sprinkled with small dark irregularly shaped spots, 1–4 mm. long. Colony reaches 25 mm. in thickness at some places, where hypoabdominal lacunae are well developed and bottom layer is remarkably thickened; zooidal stratum only 2 mm. in thickness. Crystalline needles found in test, but no perfect spicules; no system defined in zooid arrangement. This specimen differs remarkably from Pacific specimens in its larger size and lighter coloration of the colony, but can most safely be treated as a giant form of the present variety.

The type specimen of *Didemnopsis jolense* Van Name (USNM 6040), 23 mm. × 10 mm. in extent and 4 mm. in thickness, was collected during the *Albatross* Philippine Expedition, 1907–09, at sta. 5137 in the vicinity of Jolo, 20 fathoms, on Feb. 14, 1908. Test soft, gelatinous, translucent, and pale brownish; no zoochlorellae or perfect spicules included. Test somewhat frothy in consistency; bladder cells abundant, oval in shape and 55–70μ in long diameter; granular cells also oval in outline, 35–40μ in long diameter and containing 10–15 granules in each, while spherical cells are usually less than 25μ in diameter and with homogeneous contents. Pigment cells may reach 120μ in longer ones and crystalline needles found sparsely in test are very small, only 13–18μ in length.

Zooids comparatively large; thorax is 630μ in a contracted state in a specimen examined, abdomen 1 to 1½ times as long as contracted thorax, attaining 1000–1110μ in specimens examined. Zooids pigmented in dark purplish brown or dark green, especially heavily on thoracic mantle and along both sides of endostyle. Only zooids of the specimen from the Palau Islands (USNM 11438) are lightly pigmented and tinted salmon pink. Branchial aperture 6-lobed; atrial siphon short but distinct, lobation around the aperture may be indistinct in some specimens, but rather clearly defined in six (?) lobules in others. Retractile muscle up to 1½ times as long as contracted thorax. About 8 stigmata in each of three rows; many yellowish corpuscles aggregated in wall of branchial sac between stigmata. Tentacles about a dozen (?). Abdomen placed nearly vertically and intestine not curved so strongly as in *Didemnum* (*Didemnum*). Circumintestinal gland consists of about 8 longitudinal tubules running on rectum at level of middle of stomach (fig. 27*g*). One testicular follicle, proximal portion of vas deferens coils 5–7 times.

Embryos comparatively large, 1220μ in length in a measured specimen. Four pairs of ampullae present (fig. 27*h*), rarely one more excess ampulla may be seen. Larval test frothy.

Remarks.—The existence of fine crystalline needles in place of spicules, rather heavily pigmented test in most specimens, and rather massive appearance of the colony are the characteristics common to all of the specimens from the Pacific Islands, the colony from Florida, and the type specimen of *Didemnopsis jolense* Van Name from the Philippine Islands. These characteristics are considered to be enough to differentiate the present group of specimens from the typical *Trididemnum savignii* (Herdman) which is usually encrusted, contains calcareous spicules in the test, and is colored more lightly in preserved state than specimens of the present variety. On the other hand, it is very difficult to regard these characteristics as significant ones to distinguish the present form as a distinct species, because it is well known that the amount of spicules and pigment cells vary considerably in *T. savignii*. At present, however, there are no intermediate forms in the present material which combine these specimens with the typical *T. savignii*, and thus I wish to treat the present specimens provisionally as a variety of *T. savignii* and retain the name given by Van Name to the specimen from Jolo Island of the Philippine Islands for the present variety. This variety seems to be distributed widely in the tropical Pacific and also in the West Indies.

32. *Trididemnum cyclops* Michaelsen

Figure 28

Trididemnum cyclops Michaelsen, 1921, p. 19, pl. 1, fig. 10.—Hastings, 1931, p. 89, fig. 11; pl. 2, fig. B.

? *Trididemnum planum* Sluiter, 1909, p. 42, pl. 3, fig. 12; pl. 7, fig. 7.

MATERIAL EXAMINED

Gilbert Islands: Onotoa Atoll; P. E. Cloud, sta. GOC–41. Two colonies (USNM 11482).—A. H. Banner, sta. B–8. Seventeen colonies (USNM 11483).

Description.—Nineteen colonies from the Gilbert Islands were examined, the largest is 14 mm. × 12 mm. in extent and 2–4 mm. in thickness. They are massive and ovoid in shape, the surface is even and quite free from foreign matter (specimens from B–8) or carries fine snowy white sand grains (specimens from GOC–41). Color of colonies differs according to the amount and the distribution of spicules; specimens from GOC–41 are whitish at places encrusted with fine sand grains and faintly brownish at other portions which are rather sparsely impregnated with spicules so that reddish brown zooids are seen through it, while the specimens from B–8 are slightly grayish white as a whole, being tinted somewhat darker above respec-

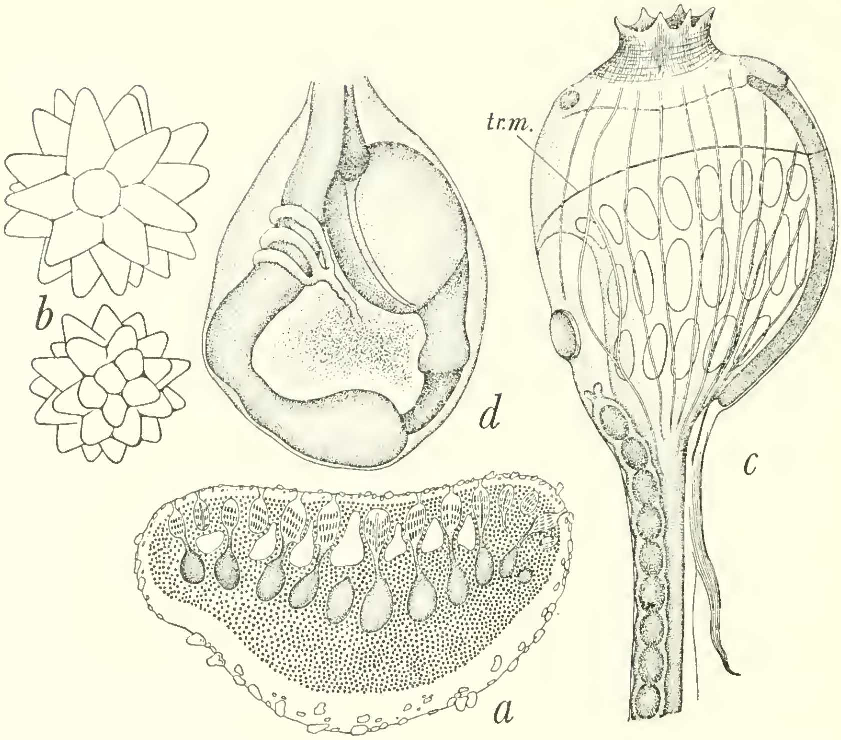

FIGURE 28.—*Trididemnum cyclops* Michaelsen: *a*, schema showing section of colony from Gilbert Islands, sta. GOC–41; *b*, spicules from same colony, × 940; *c*, right side of thorax of zooid of same colony (tr. m.=transverse muscle); *d*, abdomen of same zooid.

tive zooids, where spicules are found much less dense than in other portions. The superficial spiculeless layer is very prominent over the whole surface of colonies; it is mainly milky white, but faintly purplish brown in some parts along the periphery in some colonies, and translucent, although a small amount of fine whitish sand grains are embedded in some places within the layer in the specimens from GOC–41.

Spicules 32–53μ in diameter, about 40μ on an average, distributed evenly throughout test from bottom to surface, except the superficial spiculeless layer, densely in specimens from B–8 or somewhat sparsely in specimens from GOC–41, where the reddish-brown zooids are seen through the test. Rays rather short, stout and bluntly pointed at tip; 11–14 rays (specimens from B–8) or 12–17, about 14 on an average (specimens from GOC–41), on the equatorial plane. Many zoochlorellae, 14–16μ in diameter, found in thoracic lacunae.

Zooids rather small, contracted thorax about 500μ, and abdomen about 450μ in length. Retractile muscle short in specimens from GOC–41, but very long, approximately twice as long as contracted thorax in specimens from B–8. Usually mantle of both thorax and abdomen (more frequently on the latter) pigmented in brown or reddish brown. Branchial aperture 6-lobed, atrial aperture a round opening, margined plainly and situated at level of second transverse vessel. About 10 longitudinal muscles on each side of thorax and a delicate transverse muscle across anterior part of branchial sac along anterior margin of the first stigmatal row. A conspicuous, roundish and dark purplish-brown pigment fleck at anterior end of endostyle. Stigmatal rows 3, 8 stigmata in the first, 7 in the second, and 5 in the last row. Tentacles 6, ciliated groove a small oval opening, dorsal languets placed on left side along second stigma numbered from the dorsomedian line. Anus opens at dorsoposterior corner of thorax with two thickened lips. Proximal end of rectum considerably thickened. Circumintestinal gland situated at level of middle of stomach and consists of about three tubules. One testicular follicle, proximal part of vas deferens coils 7 times at the maximum.

Remarks.—The existence of zoochlorellae in the lacunae system is unique and not known in any other forms of *Trididemnum*. The prominent superficial spiculeless layer may also be regarded as a significant characteristic of the present species. The structures of test and zooids of *Trididemnum planum* Sluiter, 1909, seem to resemble closely those of the present species, although the existence of Zoochlorellae is not described in the former.

33. *Trididemnum viride* (Herdman)

Figure 29

Leptoclinum viride Herdman, 1906, p. 340, pl. 8, figs. 28–33.
? *Didemnopsis globuliferum* Sluiter, 1914, p. 76, fig. 17.

MATERIAL EXAMINED

Philippine Islands: Large Sibago Island; W. R. Taylor, sta. 5. Two small fragments (USNM 11646).—Baliwasan; W. R. Taylor, sta. 10. Several colonies (USNM 11649); one small colony (USNM 11659).—Cabaluay; W. R. Taylor, sta. 14. Many colonies (USNM 11796).—Punta Natangol, Basilan Island; W. R. Taylor, sta. 31. Many colonies (USNM 11661).—Kilay Island, near Langos Island; W. R. Taylor, sta. 38. Five small fragments (USNM 11680).—Balukbaluk Island; W. R. Taylor, sta. 40. Many small colonies (USNM 11640).—Boboh near Matanal; W. R. Taylor, sta. 41. Four fragments (USNM 11672).—Manicaan, 3 fath., sandy with short eelgrasses and little coral reefs; W. R. Taylor, January 1941. Nine fragments (USNM 11642).—Amoyloi Reefs, southern part of Basilan Island, 1–2 fath., sandy, stony, and coral reefs; W. R. Taylor, January 1941. Many colonies (USNM 11641).—Basilan Island, Tundun Pasil near lighthouse at Isabela Channel, 1 fath., rocky coral reef; W. R. Taylor, January 1941. Many colonies (USNM 11681).

Description.—The present species seems to be very common in Philippine waters, as there are abundant colonies in the material. Most of the specimens are rather small, even larger ones are only 30 mm. × 10 mm. or 24 mm. × 18 mm. in extent. They are 0.5 mm.–1 mm.

in thickness and the coloration of colonies varies considerably according to the amount and the physiological condition of zoochlorellae and Cyanophyceae embedded in the test. They are light grayish white, faintly greenish, or light brownish. Some colonies show brownish, yellowish brown, pinkish, or bright greenish tint. Colonies are usually encrusting the surface of some algae and thus their shape is quite irregular. No system is found in the arrangement of zooids.

Various amounts of zoochlorellae and a few Cyanophyceae are embedded in the test itself, not in the lacunae system. The former are rather small, 7.5–10μ in diameter; while the largest filament of the latter found in examined colonies is 68μ in length. In addition, a large amount of stellate calcareous spicules are distributed evenly and densely throughout the test from surface to bottom. The surface of

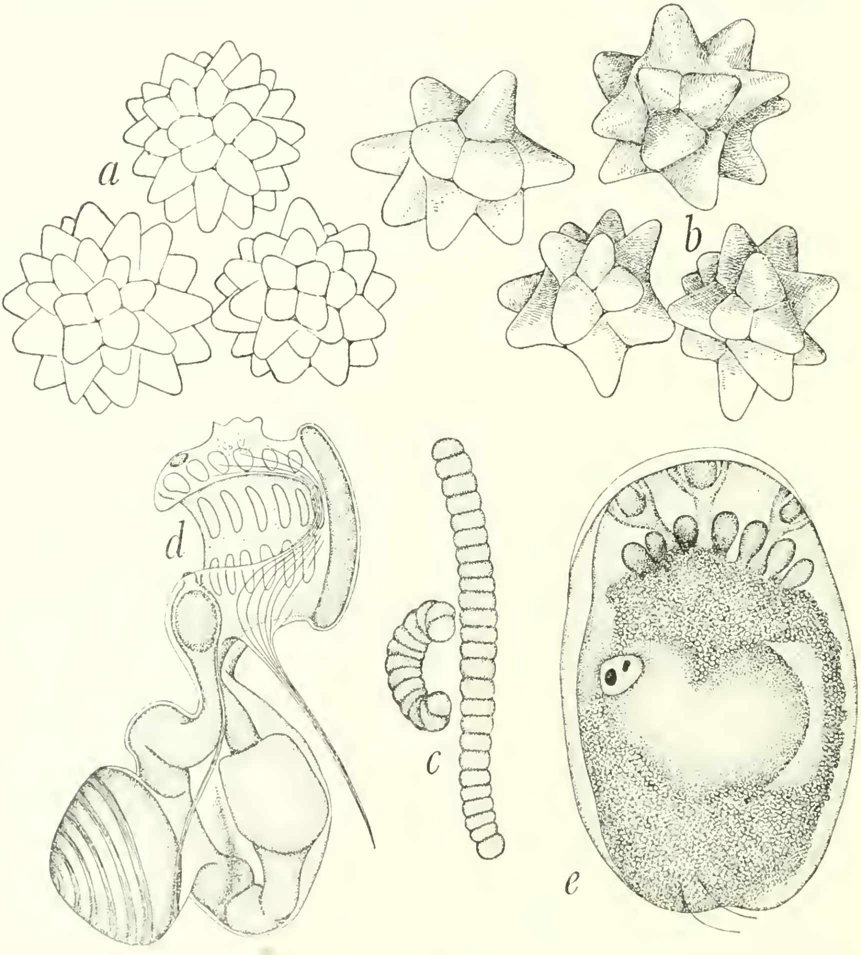

FIGURE 29.—*Trididemnum viride* (Herdman): *a*, spicules, consisting of many rays, × 940; *b*, spicules, consisting of fewer rays, × 940; *c*, cyanophyceae contained in the test, highly magnified; *d*, right side of a zooid; *e*, right side of a larva.

some of the colonies shows a kind of granulated appearance due to many aggregations of spicules on the surface, on other colonies spicules are not found so densely. The superficial spiculeless layer is defined on some colonies. Spicules are of moderate size; most frequently about 40μ in diameter, varying from 20–30μ in some colonies to 30–58μ in others. They are usually of the *moseleyi*-type, consisting of short, stout, and bluntly tipped rays; rays on the equatorial plane are 6 to 9 (about 8 on an average) to 10–14 (about 12 on an average). Some colonies contain a small amount of spicules of the *candidum*-type consisting of many small rays besides those of the *moseleyi*-type. In collections from Balukbaluk Island and Boboh near Matanal Point of Basilan Island, many small colonies are found in which the spicules of the *candidum*-type are dominant.

Zooids very small, thorax 310μ and abdomen about 200μ in length. Thoraces of zooids from larger colonies have the atrial aperture opened widely, though those from small colonies have a well-defined atrial siphon, for example in 4 mm.×1 mm. and 3 mm.×1.5 mm. colonies from Large Sibago Island and small colonies from Balukbaluk Island. It is very possible that the cloaca in many zooids of such small colonies must be extended to reach the common lacunae which has not yet developed into a spacious and complicated one, and thus the atrial siphon is formed. No atrial languet. Several longitudinal muscles are on each side of the thorax. Retractile muscle rather long, it may be up to twice as long as contracted thorax. Three rows of stigmata and 6 or 7 stigmata in each row. Alimentary canal curved as in many species of *Didemnum*. One testicular follicle, proximal part of vas deferens coils 6 or 7 times.

Trunk of larvae oval, 600–680μ in length in specimens examined. Ampullae 6 to 8 pairs. Two pigment flecks of sensory organ arranged obliquely or dorsoventrally.

REMARKS.—No references are found concerning the structure of zooids in Herdman's original description of the specimen from Ceylon. However, the greenish unicellular algae embedded in the test, as well as spicules of the *moseleyi*-type are common to both the Ceylon specimen and the present Philippine specimens. These may be regarded as reasons for identifying the present specimens as *Leptoclinum viride*.

34. *Leptoclinides reticulatus* (Sluiter)

FIGURES 30*a–g*

Didemnum reticulatum Sluiter, 1909, p. 60.
? *Didemnum albopunctatum* Sluiter, 1909, p. 58, pl. 6, fig. 8.
Leptoclinides sparsus Michaelsen, 1924, p. 336, fig. 13.
Leptoclinides reticulatus Hastings, 1931, p. 92.

MATERIAL EXAMINED

PALAU ISLANDS: Barrier reef 8 mi. NW. of Koror Island; GVF sta. 25. Six colonies (USNM 11382).—Iwayama Bay, Geruherugairu Pass; GVF sta. 85. Three small colonies attached to *Halimeda* (USNM 11449).

Gilbert Islands: Onotoa Atoll: P. E. Cloud, sta. GOC–55. One colony (USNM 11492).

Description.—Seven colonies from the Palau Islands and a single somewhat multilated one from the Gilbert Islands were examined. The largest colony is 23 mm. × 10 mm. in extent and less than 1 mm. in thickness. Test gelatinous, transparent, and contains some crystalline needles (fig. 30*e*) in the specimen from the Gilbert Islands, but many stellate spicules of 22–38μ (32μ on an average) in diameter in the Palau specimens. Spicules resemble closely those of *D. moseleyi*, 10–15 rays (about 12 on an average) on equatorial plane and short, stout and pointed rather sharply at tip. Number of spicules differs considerably according to colonies; distributed with moderate density, evenly throughout the test from bottom to surface in some colonies, while in others they are arranged in only a single layer, less densely along the upper edge of the zooidal stratum, quite sparsely in other parts of the colony. Some colonies only sparsely impregnated with spicules may contain spicules somewhat larger than those in densely impregnated colonies. Superficial spiculeless layer well defined. Well-developed hypozooidal lacunae in test so spacious that zooidal stratum and thin bottom layer are merely connected along periphery of colony and at other places where a few zooids are situated vertically; in other portions zooids are all horizontal in zooidal stratum, with dorsal sides down so that atrial apertures open to hypozooidal lacunae (fig. 30*c*). Dark bluish pigments are deposited in elongated cells in the surface layer of the zooidal stratum, or scattered throughout the whole zooidal stratum; sometimes pigment cells occur at some parts of the colony forming nearly spherical masses measuring about 0.5 mm. in diameter. Due to these pigment cells, entire colony usually a grayish or dark bluish mass with a whitish margin. Frequently pigment cells are missing above respective zooids and consequently the dark colored colony surface is sprinkled with a number of white spots (figs. 30*a*, *b*). Common cloacal apertures elliptical.

Thorax 800–1200μ, abdomen nearly as long as thorax, usually about 900μ in length. Zooids brownish in some colonies, seen through the test where spicules are very sparse. No system found in arrangement of zooids. Atrial aperture opens at level of third stigmatal row and its shape varies according to degree of contraction; it is considerably wide, roundish in shape, and does not form any siphon in some colonies, while a short but distinct siphon is formed in others. About 10 longitudinal muscles on each side of thorax. Stigmata 8 to 10 in each of four rows, 8 tentacles, dorsal languets roughly triangular in shape. Hind stomach and midintestine very distinctly defined. Generally intestine is not so strongly curved as in *Didemnum* (*Didemnum*). Anus opens at dorsoposterior corner of thorax, margin plain.

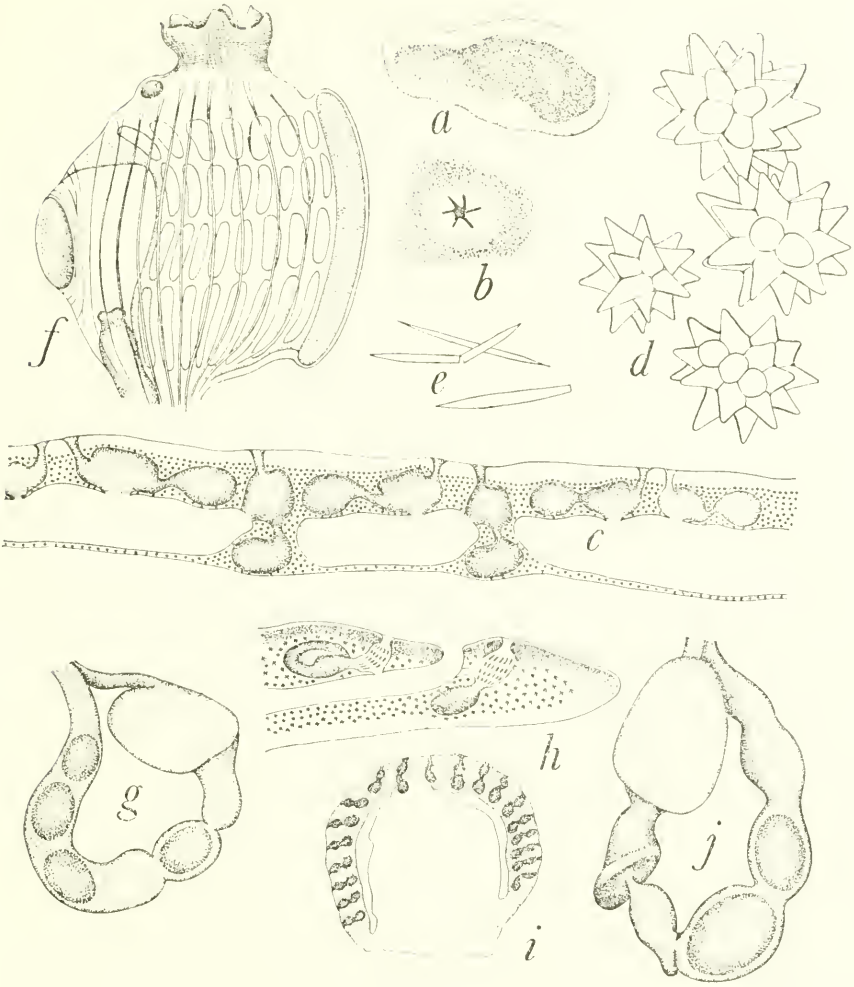

FIGURE 30.—*a–g*, *Leptoclinides reticulatus* (Sluiter): *a*, surface of small colony from Palau Islands; *b*, branchial aperture on same colony; *c*, schema showing section of colony; *d*, spicules from Palau specimens, × 940; *e*, crystalline needles found in test of the Gilbert Islands specimen; *f*, right side of thorax of a zooid of Palau specimen; *g*, abdomen of same zooid. *h–j*, *Leptoclinides hawaiiensis*, new species: *h*, schema showing section of the encrusted colony from sta. 3970; *i*, schema showing section of a massive small colony; *j*, intestinal loop of a zooid from the encrusted colony.

REMARKS.—The formation of the atrial siphon may be indistinct in some colonies and consequently the general appearance of zooids resembles closely the species of *Didemnum*. However, the location of zooids in the present specimens is distinctly characteristic of *Leptoclinides*. Probably, the present species may be regarded as one of the intermediate forms between *Leptoclinides* and *Didemnum*. The structure of the present specimens conforms to that described by

Michaelsen (1924) on *Leptoclinides sparsus*, from New Zealand, and also to that given by Hastings (1931) as the result of reexamination of the specimen of *Didemnum reticulatum* from sta. 37 of the *Siboga* Expedition. Sluiter's original description reports that the zooids in his specimens are very small, about 0.6 mm. in length, which is much smaller than in the present specimens. Probably his measurement was made on strongly contracted or bent zooids. *Didemnum albopunctatum* from the *Siboga* area also very closely resembles the present species in the appearance of the colony. If the type of this Malay species is reexamined with attention to the structure of zooids, then the relation between it and the present species will be definitely clarified.

35. ***Leptoclinides hawaiiensis***, **new species**

FIGURES 30*h–j*

HOLOTYPE.—USNM 11792: French Frigate Shoal, Hawaiian Islands; 23°45′50″ N., 166°20′50″ W., 17–17.5 fath., coarse sand, shells, coral; *Albatross* sta. 3970, May 29, 1902.

PARATYPES.—USNM 11793: Auau Channel between Maui and Lanai, off Mokuhooniki Islet, N. 3° E., 16.6 mi., 43–32 fath., yellow sand, pebbles, coral; *Albatross* sta. 3872, April 12, 1902. Two specimens (USNM 11793).

DESCRIPTION.—Three colonies from the Hawaiian Islands were examined; two smaller ones, 11 mm. × 9 mm. and 15 mm. × 12 mm. in extent and 9–12 mm. in height, are massive or nearly globular in shape, while the largest is encrusted and measures 35 mm. × 23 mm. in extent and 4 mm. in thickness. They are brownish, grayish brown or dark purplish brown in color; surface smooth in two smaller specimens, but rather uneven in the other, the milky white and translucent test irregularly ridged on the surface. Test hard, gelatinous, and comparatively tough, though translucent and contains many bladder cells. Purplish-brown pigment cells found densely scattered throughout the whole zoodial stratum or in the thoracic layer of the stratum, but extremely scarce in other layers or parts of the colony which are milky white or pale grayish brown. Spicules found only in the largest colony, the holotype (USNM 11792), extraordinarily large, up to 100–176μ in diameter in larger ones, and distributed rather sparsely in only the unpigmented layers lower than the abdominal layer of the zoodial stratum. About 12 rays on the equatorial plane, may be fairly long and with the pointed tip in some perfectly preserved spicules. One of the colonies, the paratype (USNM 11793), contains crystalline needles in the test, while the other includes neither spicules nor needles in the test. Hypozoodial lacunae well developed. A small common cloacal aperture 0.9 mm. in diameter found at top of 15 mm. × 12 mm. colony. No distinct system found in arrangement of zooids.

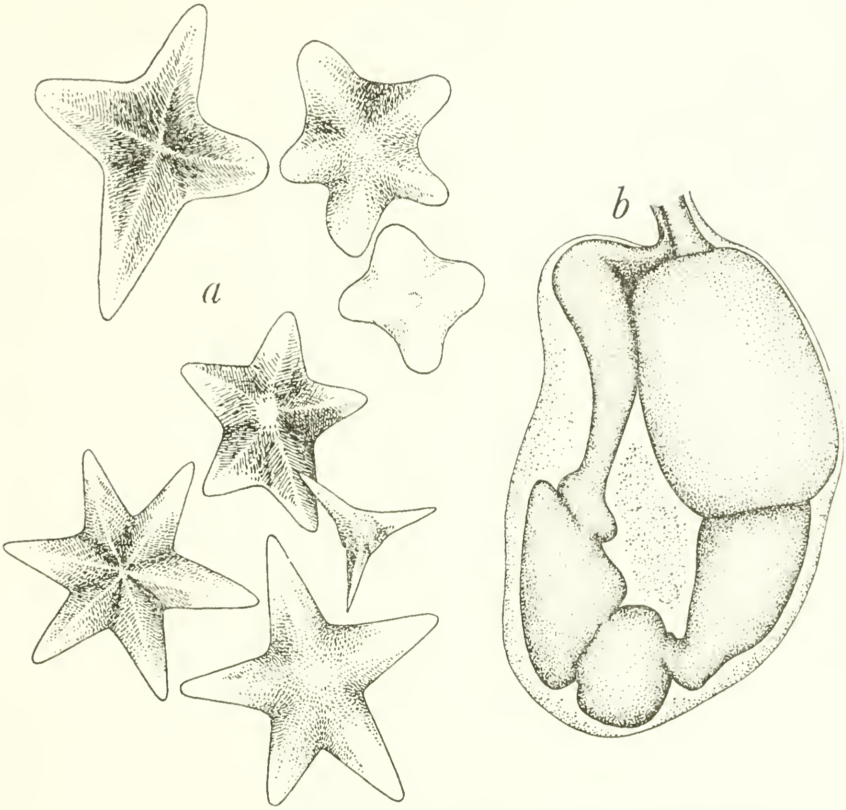

FIGURE 31.—*Echinoclinum philippinense*, new species: *a*, spicules, × 400; *b*, abdomen.

Thoraces and larger abdomens nearly equal in length. In holotype colony lobes around respective branchial apertures each contain a single small spicule, consequently closed branchial apertures are marked with 5 or 6 white particles. Atrial siphon protrudes from dorsoposterior corner of thorax. About 8 longitudinal muscles on each side of thorax. Stigmata 6 to 8 in each of four rows, 6 tentacles(?). Alimentary canal not curved strongly on distal branch. Testicular follicles 4 to 6, proximal part of vas deferens coils 4 to 5½ times.

36. *Echinoclinum philippinense*, new species

FIGURE 31

HOLOTYPE.—USNM 11790: Philippine Islands; Punta Natangol, Basilan Island, ½ fath., sandy, rocky coral reef; W. R. Taylor, sta. 31, January 1941.

PARATYPE.—USNM 11791: Baliwasan, near the seafood cannery; W. R. Taylor, sta. 10, January 1941.

DESCRIPTION.—There are two small colonies from the Philippine waters, the paratype, 2.5 mm. × 1.5 mm. in extent and contains only several zooids and the holotype, 4 mm. × 1.8 mm. in extent, the thickness is less than 1 mm. in both colonies. Test soft, gelatinous, transparent, contains many zoochlorellae within, not in the lacunae, also curiously shaped spicules. Zoochlorellae 13–15μ in diameter; spicules very large (fig. 31*a*), larger ones reach about 130μ in length. They each consist of 3 to 6 thick rays radiating on a plane; among them, pentacle-shaped ones are most abundant, whereas hexagram-shaped or trifid ones are very scarce. Hypozooidal lacunae not found in test. Contracted thorax about 320μ, abdomen 400–450μ in length. No system formed in arrangement of zooids. Branchial aperture 6-lobed, atrial aperture a wide opening without atrial languet. About 6 stigmata in each of four rows.

REMARKS.—This is the second species of the genus *Echinoclinum* and differs from the type species of the genus, *E. verrilli* Van Name, in the appearance of spicules which have the form of tetrahedron with four elongated points in the type species. The existence of zoochlorellae in the test in the present new species is also unique.

37. *Lissoclinum fragile* (Van Name)

FIGURES 32*a,b*

Diplosomoides fragile Van Name, 1902, p. 370, pl. 53, figs. 57–58; pl. 61, fig. 126.
Lissoclinum fragile Van Name, 1921, p. 338, figs. 31–32.—Van Name, 1924, p. 26.—Van Name, 1930, p. 442, fig. 19.—Van Name, 1945, p. 113, fig. 53.—Tokioka, 1954a, p. 248, pl. 24, figs. 6–7; pl. 25, figs. 1–2.

MATERIAL EXAMINED

PHILIPPINE ISLANDS: Small Sibago Island; W. R. Taylor, sta. 7. One small colony (USNM 11668).—Baliwasan; W. R. Taylor, sta. 10. One small, mutilated colony (USNM 11654).—Basilan Island, Tundun Pasil, near lighthouse at Isabela Channel, 1 fath., rocky, coral reef; W. R. Taylor, January 1941. Three small colonies (USNM 11685).

PALAU ISLANDS: Iwayama Bay; GVF sta. 100. One small colony (USNM 11465).—Iwayama Bay, east side of Oyster Pass; GVF sta. 220. Eight fragments (USNM 11439).

DESCRIPTION.—Nine small colonies from the Palau Islands and five small pieces from the Philippine Islands were examined. The largest is 27 mm. × 13 mm. in extent and only 0.5 mm. in thickness in most parts, but up to 1 mm. along the periphery. Test extremely fragile, though impregnated with spicules. Distribution of spicules differs somewhat among colonies; usually so sparse around the zooid and in the zooidal stratum that dark brownish zooids are seen through the test, and areas around respective zooids seen as faintly brownish flecks. Spicules found most densely along periphery of colony and sometimes rather densely in surface layer of zooidal stratum, rarely in bottom stratum; thus periphery of colony nearly always whitish. Generally spicules of *candidum*-type and rather small, but may be of moderate size (about 30μ in diameter), slightly larger than those of *Didemnum candidum;* rays shorter and less numerous than in those of *Didemnum candidum* (Savigny). Rays comparatively large, acutely pointed at tip and 9–11 on the equatorial plane in larger spicules, but short, bluntly pointed at the tip and 11–13 (12 on an average) on equatorial plane in smaller spicules which are found most abundantly. The existence of spicules with slightly longer rays seem to be characteristic of the species. Lacunae very spacious and both thorax and abdomen exposed in the lacuna; abdomens laid horizontally on thin bottom stratum. Common cloacal aperture oval, as large as width of the zooid, margin supported by about 10 riblike aggregations of spicules in some colonies (fig. 32*a*). Thorax comparatively large, usually found in an expanded state. Atrial aperture extremely wide. Stigmata 6 to 8 in each of four rows. Intestine not curved sharply in distal branch. Two testicular follicles.

38. *Lissoclinum molle* (Herdman)

FIGURES 32*c,d*

Diplosomoides molle Herdman, 1886, p. 310, pl. 42, figs. 5–16.—Sluiter, 1909, p. 85, pl. 8, fig. 8.

MATERIAL EXAMINED

PALAU ISLANDS: Fringing reef of small islet in lagoon (Meharehar) of Eil Malk, GVF sta. 252. More than 10 colonies (USNM 11434).

DESCRIPTION.—About 10 small colonies from the Palau Islands were examined. They are attached to fine branches of an alga of Corallinaceae and the largest is 5 mm. × 2 mm. in extent. Surface of colony whitish because of spicules in the test, and the situation of respective zooids is shown by reddish-brown flecks, as spicules found less densely around the zooid and consequently zooids are seen through the test. Yellowish-orange pigments deposited between zooids. The underside of the colony snowy white. Spicules small, $12–26\mu$ and about 18μ on an average, and of the *candidum*-type. Atrial aperture a wide opening in a fully expanded state as in species of *Leptoclinum*. About 6 stigmata in each of four rows. Abdomen laid horizontally on thin bottom stratum. Intestine not curved strongly on its distal branch. Two (?) testicular follicles. Budding found in nearly all examined zooids.

REMARKS.—The distinction between the present species and *Lissoclinum fragile* is only that the former is variously colored on the colony surface and maintains a moderate thickness, while the latter is always snowy white and extremely thin. The coloration of the present specimens differs considerably from the grayish tint of the type specimen preserved in Formol, but resembles that of the *Siboga* specimens, which are brown or grayish brown in alcohol.

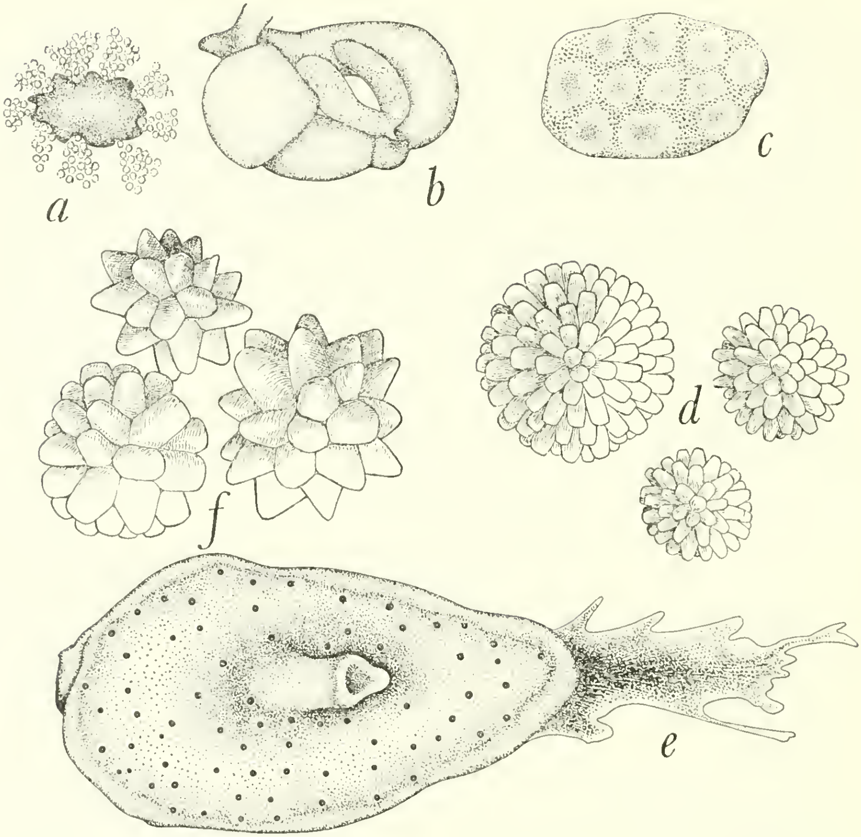

FIGURE 32.—*a*, *b*, *Lissoclinum fragile* (Van Name): *a*, common cloacal aperture found on colony from Palau Islands; *b*, abdomen from same colony, from attachment side, showing two immature testicular follicles. *c*, *d*, *Lissoclinum molle* (Herdman): *c*, small colony from Palau Islands; *d*, spicules, × 1800. *e*, *f*, *Lissoclinum pulvinum* (Tokioka): *e*, 6 mm. colony from the Gilbert Islands, B–5, common cloacal aperture open at tip of siphon; *f*, spicules from the Palau Islands colonies, stas. 261 and 25–865, × 940.

39. *Lissoclinum patella* (Gottschaldt)

Didemnoides patella Gottschaldt, 1898, p. 651.
?*Didemnoides sulcatum* Gottschaldt, 1898, p. 651.
Didemnum (*Didemnum*) *patella* Tokioka, 1950, p. 115, fig. 1.

MATERIAL EXAMINED

PHILIPPINE ISLANDS: Punta Natangol, Basilan Island; W. R. Taylor, sta. 31. Two colonies (USNM 11664).—Balukbuluk Island; W. R. Taylor, sta. 40. Two fragments (USNM 11637).—Basilan Island, Tundum Pasil, near the lighthouse at Isabela Channel, 1 fath.; W. R. Taylor, January 1941. Two colonies (USNM 11683).

PALAU ISLANDS: Ngaremedin, east side of Urukthapel Island; GVF sta. 111. Two colonies (USNM 11419).

DESCRIPTION.—Two colonies from the Palau Islands and five from the Philippine Islands were examined. The largest is 45 mm. × 25 mm. in extent and 3.5 to about 10 mm. in thickness. Test soft, gelatinous, pale brown or brownish; however the periphery and underside of the colony are quite whitish because these parts are very densely impregnated with spicule which are very large and distributed in the zooidal stratum in a moderate density in the surface layers, but somewhat sparsely in lower layers. Nearly spherical in shape, 63–76μ in diameter in the Palau specimens, while 75–88μ in the Philippine specimens; surface usually worn and marked with a number of low triangular elevations. Many zoochlorellae contained in lacunae system and consequently preservative usually becomes green. About 12 stigmata in each of four rows.

REMARKS.—*Didemnoides sulcatum* described by Gottschaldt in the same paper next to the present species is regarded as a form of *D. patella* which is grooved strongly on the colony surface.

40. *Lissoclinum pulvinum* (Tokioka)

FIGURES 32*e,f*

Didemnum (*Didemnum*) *gottschaldti* Tokioka, 1950, p. 118, fig. 2.
not *Didemnum gottschaldti* Hartmeyer, 1905, p. 1449.
Didemnum (*Didemnum*) *pulvinum* Tokioka, 1954a, p. 247, pl. 23, figs. 8–10: pl. 24, figs. 1–5.

MATERIAL EXAMINED

PHILIPPINE ISLANDS: Large Sibago Island; W. R. Taylor, sta. 5. Two colonies (USNM 11647).—Baliwasan; W. R. Taylor, sta. 10. One colony (USNM 11653).—Sangboy Island; W. R. Taylor, sta. 11. Four small pieces (USNM 11671).—Cabaluay; W. R. Taylor, sta. 14. More than 35 small colonies (USNM 11669).—Punta Natangol, Basilan Island; W. R. Taylor, sta. 31. Many small colonies (USNM 11663).—Kilay Island, near Langos Island; W. R. Taylor, sta. 38. More than 40 colonies (USNM 11678).—Balukbuluk Island; W. R. Taylor, sta. 40. Two colonies (USNM 11638).—Boboh, near Matanal Point; W. R. Taylor, sta. 41. One small colony (USNM 11674).—Manicaan, 3 fath., sandy with short eelgrasses and little coral reefs, W R. Taylor, January 1941. Four colonies attached to *Valonia*.—Basilan Island, Tundun Pasil, near lighthouse at Isabela Channel, 1 fath., rocky coral reef; W. R. Taylor, January 1941. Twelve colonies (USNM 11684).

PALAU ISLANDS: Barrier reef 8 mi. NW. of Koror Island; GVF sta. 25. Two colonies (USNM 11386).—Ngerkuid, west of Eil Malk; GVF sta. 261. Three colonies (11396) growing with *Didemnum* (*D.*) *ternatanum* (Gottschaldt) (USNM 11398).

GILBERT ISLANDS: Onotoa Atoll; A. H. Banner, sta. B–5. Seventeen colonies (USNM 11480).—P. E. Cloud, sta. GOC–39. Twenty-six colonies (USNM 11487).—P. E. Cloud, sta. GOC–41. A number of colonies crowded on a large, dead reef coral 130×110 mm. in extent and 90 mm. in height (USNM 11538).

DESCRIPTION.—Many small, roundish, or slightly elongated colonies from the Gilbert Islands, two small colonies from the Palau Islands and many small ones from the Philippine Islands were examined. Larger colonies are 10 mm.×7 mm. to 14 mm.×5 mm. in extent and 1 mm. (in smaller colonies) to 2–3.5 mm. (in larger colonies) in thickness. They are attached to dead reef corals, *Halimeda* or *Valonia*, whitish, faintly yellowish orange, pale brownish, grayish brown or greenish. Such coloration is due partly to zoochlorellae contained in the lacunae system and partly to the amount of pigment deposited in the surface layer of the zooidal stratum. Spicules found most densely at the periphery and the bottom layer of the colony, consequently the margin and underside of colonies are usually whitish. Spicules decrease, however, in varying degrees in the central portion on the surface of the colony, especially markedly above respective zooids. There the greenish or brownish (USNM 11678 from the Philippines) tint of zoochlorellae is seen through the translucent test. Spicules distributed nearly evenly in some of the Palau specimens, in others rather dense in the surface layer of the zooidal stratum, but quite sparse between zooids. The size of spicules varies considerably, always smaller than in *Lissoclinum patella;* 20–25μ in diameter in some colonies, but 30–45μ in others. Generally of the *candidum*-type, but larger ones often of the *patella*-type, and worn on surface; sometimes spicules consist of rather fewer rays (fig. 32*f*). In some Palau specimens, small granules formed on surface of colony by aggregated spicules, especially numerous at some places along the periphery; there such granules elongated to small finger-shaped protuberances. Superficial spiculeless layer distinct. Thoracic and hypoabdominal lacunae well defined and contain a large amount of zoochlorellae, 11–14μ (Philippine specimens) to 18–21μ (specimens from the Gilbert Islands), usually 15–18μ in diameter. One or two common cloacal apertures in smaller colonies, up to four in larger ones. In some specimens, aperture opens at end of a short siphon (fig. 32*e*), in others formation of siphon quite indistinct. Abdomen comparatively small, approximately half as long as moderately contracted thorax. Branchial aperture 6-lobed, thoracic organ situated near posteroventral side of the wide atrial aperture at level of second transverse vessel on each side of thorax, but may be missing in some dissected zooids. Six to seven stigmata in each of four rows, wall of branchial sac between stigmata pigmented brownish in some specimens. One testicular follicle; proximal part of vas deferens curves very slightly, never being coiled.

REMARKS.—The pigmentation observed on some preserved specimens seems to indicate that those colonies might be pale vermilion or salmon pink when alive.

41. *Leptoclinum virens* Hartmeyer

FIGURE 33

Diplosoma viride Herdman, 1906, p. 341, pl. 8, figs. 34–40; pl. 9, fig. 6.
not *Leptoclinum viride* Herdman, 1906, p. 340, pl. 8, figs. 28–33.
Leptoclinum virens Hartmeyer, 1909, p. 1456.—Tokioka, 1942, p. 500, fig. 2; pl. 4, figs. 1–3.
Diplosoma virens, Hastings, 1931, p. 102, fig. 16; pl. 3, figs. A, B.

MATERIAL EXAMINED

Philippine Islands: Punta Natangol, Basilan Island; W. R. Taylor, sta. 31. Four colonies (USNM 11662).—Balukbuluk Island; W. R. Taylor, sta. 40. Two colonies (USNM 11639).—Boboh, near Matanal Point; W. R. Taylor, sta. 41. One colony (USNM 11673).—Manicaan, 3 fath., sandy with short eelgrasses and little coral reefs, W. R. Taylor, January 1941. One colony (USNM 11645).

Palau Islands: Iwayama Bay, Geruherugairu Pass; GVF sta. 85A. Six specimens (USNM 11452).—Fringing reef of small island in lagoon (Meharehar) of Eil Malk; GVF sta. 252. Six small specimens attached to coralline algae (USNM 11435).

Marshall Islands: Ebon Atoll, M. W. de Laubenfels, no. M–139, July 5, 1949. One colony encrusting a reef coral (*Scriatopora*?) (USNM 11541).

Gilbert Islands: Onotoa Atoll; P. E. Cloud, sta. GOC–44. Many small colonies (USNM 11479).

Description.—Many small colonies from the Gilbert Islands, 8 small colonies from the Philippines, 1 dried specimen from Ebon Atoll, and 12 small colonies from the Palau Islands were examined. The largest is 20 mm. × 12 mm. in extent and 2–3 mm. in thickness, smaller colonies are usually about 1 mm. thick. Colonies are all encrusted; small colonies simply elliptical or roundish in outline, larger ones generally irregularly lobated. Living animals vivid cerulean blue or bright green, but preserved specimens fade to yellowish brown or turn dark brownish. Test gelatinous, not so soft, translucent or transparent, and containing no spicules or other materials. Surface of colony smooth, quite free from foreign matter. Abundant zoochlorellae in lacunae. Zooids of the colony from Manicaan Island, Philippine Islands, are dark brownish, but whether this coloration is natural is questionable. Atrial aperture very wide. Six stigmata in each of four rows. Hind stomach clearly defined by distinct constrictions between it and the pyloric end of stomach and midintestine; usually enveloped

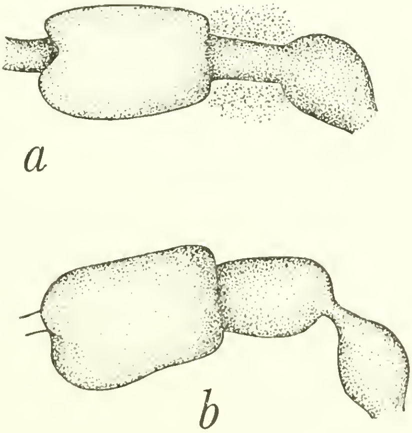

Figure 33.—*Leptoclinum virens* Hartmeyer. Gastric region of the alimentary canal of a zooid of colony *a*, from the Gilbert Islands and *b*, from Manicaan, the Philippine Islands. Hind stomach narrowed in former, but rather swollen in latter; well defined in both specimens.

by a compact tissue. Surface of stomach sometimes lightly pigmented. Testicular follicles two, usually pigmented rather heavily in purplish brown. Two follicles difficult to discern distinctly in a fully matured state, as both swollen follicles are attached to each other tightly, forming a single, nearly spherical compact mass, the cleft between the two follicles being completely covered by dilated proximal part of vas deferens. Cleft discernible as a whitish line across the purplish brown sphere when vas deferens is picked off the testis. Matured egg very large.

42. *Leptoclinum mitsukurii* (Oka)

Diplosoma mitsukurii Oka, 1892, p. 265, fig. 1.
Leptoclinum okai Tokioka, 1949a, p. 5, pl. 2, figs. 8–9.
Leptoclinum mitsukurii Tokioka, 1953a, p. 201, fig. 5; pl. 24, figs. 1–5.

MATERIAL EXAMINED

Japan: Honshu, off Omai Zaki Light N.17°E., 14.5 mi.; *Albatross* sta. 3730. One colony (USNM 11631) attached to *Polyclinum constellatum* Savigny (USNM 11630).

Thailand: Langsuen; from a bamboo stake; H. M. Smith, September 22, 1923. One colony (USNM 11757).

Description.—One small piece from Japanese waters and an extensive colony from Thailand were examined. The former is only 5 mm. × 3 mm. in extent and consists of about 20 zooids, while the latter encrusts dead bryozoans, living barnacles and oysters together in 1 mm. thickness and consequently quite irregular in outline, the widest flat part of the colony is seen on the oyster shell and there it reaches to 30 mm. × 20 mm. in extent. Test soft, gelatinous, extremely delicate and transparent. Lacunae very spacious, thoraces and abdomens almost all exposed in lacuna. Stigmata 7 to 8 (usually 8) in each of four rows. Mantle of abdomen enveloping alimentary organs quite devoid of pigment in all examined zooids. Two testicular follicles.

Remarks.—The colony of *Leptoclinum macdonaldi* (Herdman) has considerably less spacious lacunae than *L. mitsukurii* (Oka) and more stigmata are found in each row, the specimens of *L. macdonaldi* from the Philippine waters have 12–14 stigmata in each row on each side. *Leptoclinum caliciforme* Sluiter from the tropical Pacific shows a peculiar style of attachment; it attaches to the substratum by a small, usually central part of the underside of the colony. The present species, however, encrusts various objects with the whole underside of the colony.

42a. *Leptoclinum* species

MATERIAL EXAMINED

Philippine Islands: Pangapuyan Island, Bavara at the other side of Sitio Pangapuyan, 1 fathom, sandy, muddy, stony, with eelgrasses, W. R. Taylor, collector, January 1941. One colony (USNM 11797).

Description.—A small 4 mm. long piece of colony probably belonging to *Leptoclinum* was found in the sample from Bavara in Pangapuyan Island, the Philippine Islands. Test soft, gelatinous and transparent, lacunae very spacious. About 7 stigmata in each stigmatal row. From these characteristics it is clear that this does not belong to *Leptoclinum macdonaldi* (Herdman). Probably this is a fragment of the colony of *L. mitsukurii* (Oka) or *L. calciforme* Sluiter. As the style of attachment is unknown in the present specimen, further identification is impossible at present.

Family Polycitoridae

43. *Clavelina fecunda* (Sluiter)

FIGURE 34

Podoclavella fecunda Sluiter, 1904, p. 7, pl. 3, figs. 23–24.

MATERIAL EXAMINED

PALAU ISLANDS: Reef 1¾ mi. S. of Ngaremediu, east side of Urukthapel; GVF sta. 227. Three specimens (USNM 11448).

DESCRIPTION.—Three individuals from the Palau Islands were examined. They are respectively 12, 14, and 18 mm. in length and found in a solitary state, although it is uncertain whether these individuals were connected by a stolon when alive or if isolation is their natural characteristic. The animal is elongated, narrowed posteriorly, and attached to the substratum by the posterior end; the basal one-fourth of the body somewhat swollen, hardened, and thus differentiated distinctly as a short peduncular portion. Test covering body proper gelatinous but rather hard, slightly milky white, smooth on the surface and transparent, while that of peduncular portion is hard, yellowish white, translucent, wrinkled, and carries some foreign matter on the surface. Zooids taken from test strongly contracted in all specimens and only 6.5 mm. in length; thorax and abdomen nearly equal in length. Both apertures roundish and plainly margined. Anterior half of thorax nearly transparent except the anterior part of endostyle, dorsal ganglion, and a small roundish pigment fleck situated on each side of the dorsal ganglion, all of these deep purplish brown. Posterior half of the thorax and stomach side of abdomen pigmented rather heavily. The coloration when the animals were alive may have been bluish.

Both branchial and atrial siphons very short, situated at the anterior side of the thorax; about a dozen longitudinal muscles on each side of thorax, all very strong. A very prominent incubatory pouch formed on dorsoposterior part of thorax, and posterior portion of pouch containing many fecundated eggs strongly projects from thorax. In zooids examined, there are as many as 42 embryos and fecundated eggs in various developmental stages. About 20 stigmatal rows, 50–60 stigmata in each row. Tentacles in an examined zooid 14 in number, also a few minute ones; usually larger and smaller ones alternate regularly. Ciliated groove an oval opening, slightly elongated longitudinally. Dorsal languets remarkably large, arranged on the dorsomedian line; horizontal membrane well developed along each transverse vessel. Stomach situated nearly at middle of contracted abdomen, globular and smoothly surfaced. Hind stomach orange, midintestinal portion somewhat greenish; both parts very short, the boundary between them rather indistinct, especially as the greenish coloration of the distal part of the latter fades gradually and continues to rectum without any clear constriction or any remarkable change of coloration or appearance of intestinal wall. Anus opens at dorsoposterior corner of thorax, the margin divided very distinctly into about 20 small lobes, some of which may be subdivided into 2 lobules. Testicular follicles small and very numerous, nearly 100; matured ova in ovary also relatively abundant, approximately a dozen in an examined zooid.

Embryos rather small, nearly oval in shape. Three attachment processes, roundish in outline and with short but stout stalks; arranged in a triangle, left dorsal one situated slightly ventrally to the right dorsal process (fig. 34*h*). Two pigment flecks of the sensory organ arranged anteroposteriorly. Distal part of tail always held between ventral attachment process and two dorsal ones.

REMARKS.—The present specimens differ rather distinctly from the original descriptions given by Sluiter in the situation of the incubatory pouch and the appearance of the anus. Sluiter (1904) states "Vorn bildet sie, links von Kiemensack, den oben erwähnten geräumigen Brutraum, welcher ganz mit Embryonen gefüllt ist" (p. 7); the pouch in the present specimens, however, is clearly situated on the right side of the thorax, and this is the general situation of the incubatory pouch in ascidians. In Sluiter's original specimens, the anus seems to be situated more anterior than in the present specimens and plainly margined as shown in his description " . . . welcher halbwegs des Kiemensackes in den glattrandigen aber weiten After mündet" (p. 8). These differences are, however, very probably attributable to the strongly contracted state of Sluiter's original specimens, under such unfavorable condition it is very difficult to find out exactly the natural appearance of these organs. The present species differs distinctly from *Clavelina molluccensis* in the following ways: (1) solitary life of *C. fecunda;* (2) test is thick and hard even in the part enclosing the thorax in *C. fecunda*, while it is very thin and soft in the corresponding portion in *C. molluccensis;* (3) thoracic, and also abdominal longitudinal muscles are very strong, consequently all zooids are found in a strongly contracted state in *C. fecunda*, while zooids of *C. molluccensis* are found rather in an extended state; (4) margin of anus is not cut into lobes in *C. molluccensis*, while it is distinctly lobed in *C. fecunda*.

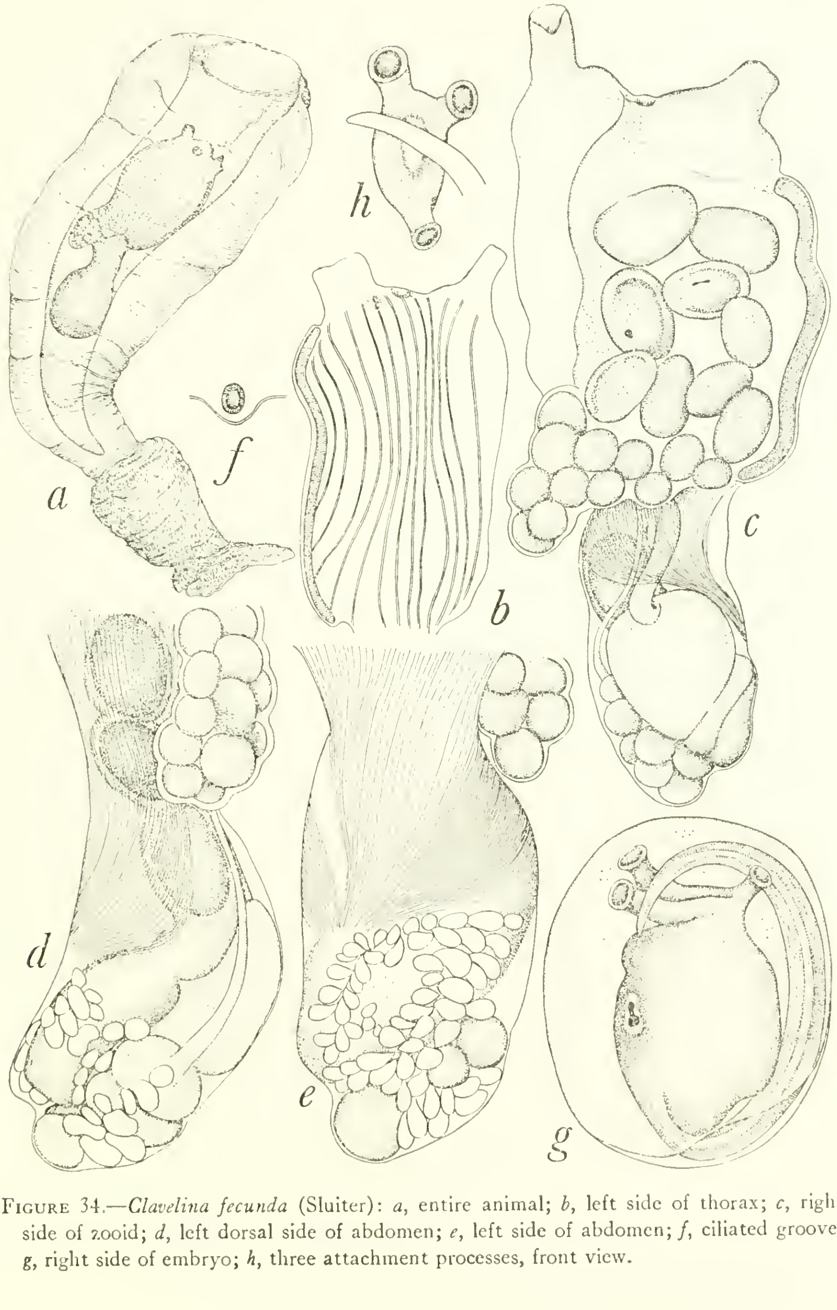

Figure 34.—*Clavelina fecunda* (Sluiter): *a*, entire animal; *b*, left side of thorax; *c*, right side of zooid; *d*, left dorsal side of abdomen; *e*, left side of abdomen; *f*, ciliated groove; *g*, right side of embryo; *h*, three attachment processes, front view.

Clavelina coerulea Oka (1934) from Japanese waters near Kyûsyû Island resembles the present form very closely. It differs, however, from the present species in the appearance and arrangement of muscles on the mantle body and the appearance of the anus; fine, obliquely running muscles are found only on the thorax and the anus is cut into a pair of smoothly margined lobes in *C. coerulea.*

DISTRIBUTION.—Formerly reported only from the *Siboga* area.

44. *Clavelina molluccensis* (Sluiter)

FIGURE 35

Podoclavella molluccensis Sluiter, 1904, p. 5.—Hastings, 1931, p. 82, pl. 1, fig. F.
Clavelina (Podoclavella) meridionalis Sluiter, 1895, p. 165, pl. 6, figs. 1–4. (Not *P. meridionalis* Herdman.)
Podoclavella meridionalis Pizon, 1908, p. 197, pl. 9, figs. 1–4. (Not Herdman.)
Clavelina molluccensis Van Name, 1918, p. 130, figs. 85–87.

MATERIAL EXAMINED

PALAU ISLANDS: Iwayama Bay, east side of Oyster Pass: GVF sta. 220. One small fragment (USNM 11445).—Iwayama Bay, mouth of Oyster Pass; GVF sta. 236A. One large colony (USNM 11425).

DESCRIPTION.—Two colonies from the Palau Islands were examined. One consists of many zooids ensheathed in respective tests, fused at the basal end of the body and forming a large mass measuring about 40 mm. in length; the other is a small fragment including only a single perfect zooid. The fusion between zooids is made somewhat irregularly, never forming a regularly fasciated colony like that found in *Clavelina fasciata* Van Name.

Test enclosing thoracic portion of zooid very soft and quite transparent, but that enclosing abdomen is translucent, rather hard, finely wrinkled, and carries a small amount of mud or fine sand grains on the surface. Test of proximal half of abdominal region contains many stolonial vessels running through it, each ending in a slightly swollen terminal; vessels usually faintly colored purplish brown. Coloration when the animals are alive is unique: body dark blue and anterior portion of zooid surrounding branchial and atrial apertures a very bright yellow. In preserved specimens color varies considerably individually; may be dark purplish in some zooids, quite colorless in others.

Zooids from larger colony 23–25 mm. in length, but those from the smaller piece only 15 mm. in length even when enveloping test is included in measurement. Thorax and abdomen nearly equal in length, sometimes latter slightly longer than former. Both branchial and atrial apertures plainly margined. From 12–25 longitudinal muscles on each side of thorax, several dorsal ones extremely fine; muscles not so strong that all examined zooids were found nearly in an extended state. No distinct transverse muscles observed. The 15 mm. long individual has 15–16 stigmatal rows, and 22–29 rows in examined zooids from the larger colony. In larger zooids 70–80 stigmata per

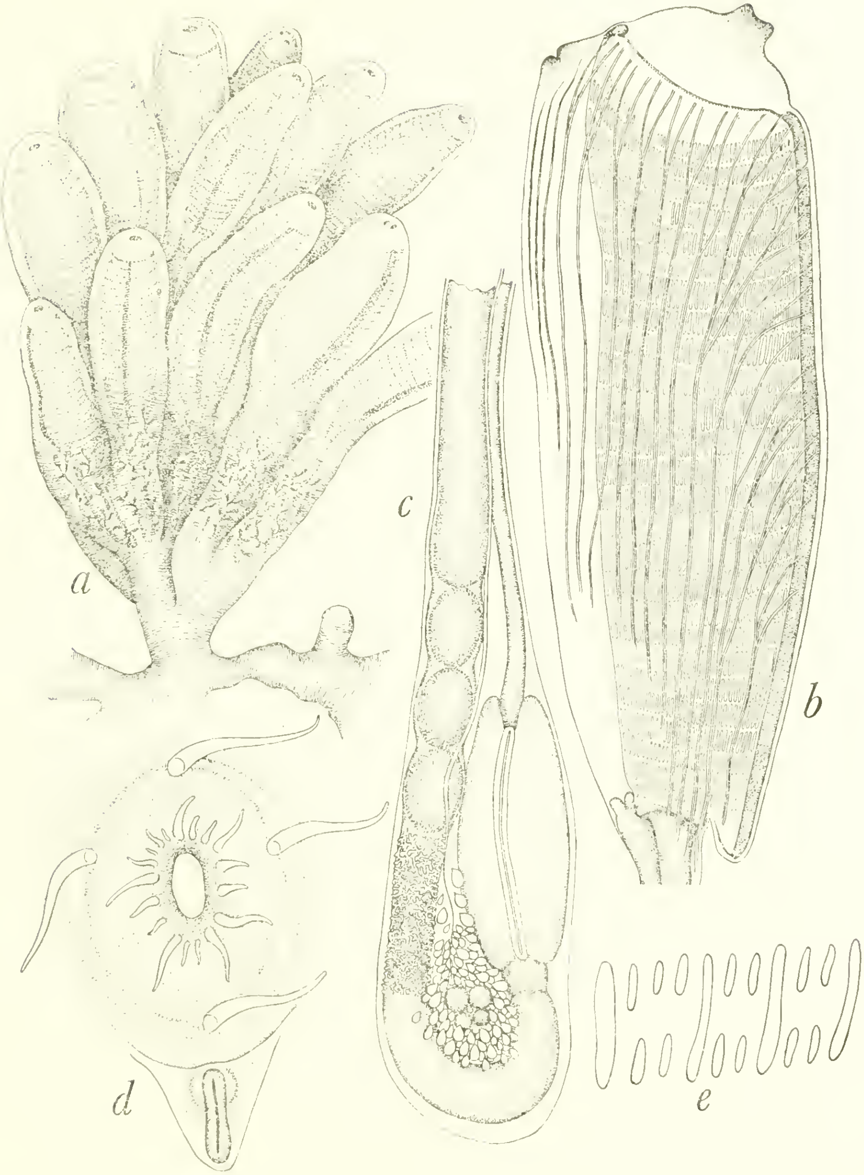

FIGURE 35.—*Clavelina molluccensis* (Sluiter): *a*, tuft in the larger colony; *b*, right side of thorax; *c*, left side of abdomen; *d*, tentacles and ciliated groove; *e*, stigmata of the first row.

row in middle part of branchial sac. Frequently some stigmata of first row divided into anterior and posterior halves (fig. 35*e*). Tentacles large, medium, small, and minute; larger ones are 4 to 6, medium ones 6, smaller ones about 10 in number, also a few minute ones. Probably 6 large, 6 medium, 12 small and minute might be the standard formula of the arrangement of tentacles. Larger tentacular ring situated far posterior to ring comprising medium and smaller tentacles. Ciliated groove elongated, this shape differs distinctly from that of *C. fecunda* and *C. fasciata*, in which the groove is a crescent cleft laid transversely. Dorsal languets long, located along dorsomedian line, horizontal membranes well developed along respective transverse vessels. Cardiac end of stomach situated approximately at posterior quarter of abdomen. Stomach elongated, with four longitudinal ridges including typhlosole; its surface quite smooth. Hind stomach very short, midintestine indistinct. Circumintestinal gland consists of many whitish tubules irregularly creeping in range between posterior end of hind stomach and middle of stomach. Formation of fecal pellets observable only in proximal part of ascending branch of intestinal loop. Anus opens at dorsoposterior corner of thorax, slightly posterior to last stigmatal row, bilobed, margin of each lobe plain. Testicular follicles small and very numerous, probably 200 or more in a fully mature state; usually distributed on left side of intestinal loop posterior to middle of stomach, although a few may also be found on right side in a fully mature state. Ovary situated near the center of gonad.

Remarks.—Sluiter (1904) and Van Name (1918) mention that there are transverse muscles on the thoracic mantle, but no such muscles were found in examined zooids of the present colonies. In the point that only the longitudinal muscles are defined on the thoracic mantle, the present specimens closely resemble *Stereoclavella australis* or *Stereoclavella* sp. described by Herdman (1899), but the coloration of the present specimens seems to differ considerably from that of Herdman's species. *Clavelina coerulea* Oka known from Kyûsyû Island, Japan, also closely resembles the present specimens in the structure of the zooid, but respective zooids are connected to the stolon individually and fusion between the abdominal portions, or bundle formation of zooids is unknown.

Distribution.—NW. Australia and the Great Barrier Reef

45. *Clavelina (Synclavella) arafurensis* Tokioka

Figure 36

Clavelina (Synclavella) arafurensis Tokioka, 1952, p. 97, fig. 5.

MATERIAL EXAMINED

Palau Islands: Iwayama Bay, east side of Oyster Pass; GVF 220. One small colony consisting of two cormidia (USNM 11444).—Iwayama Bay, mouth of Oyster Pass; GVF sta. 236A. One large colony (USNM 11426).

Description.—A large colony, consisting of many cormidia (USNM 11426) and a small one consisting of two cormidia (USNM 11444) from the Palau Islands were examined.

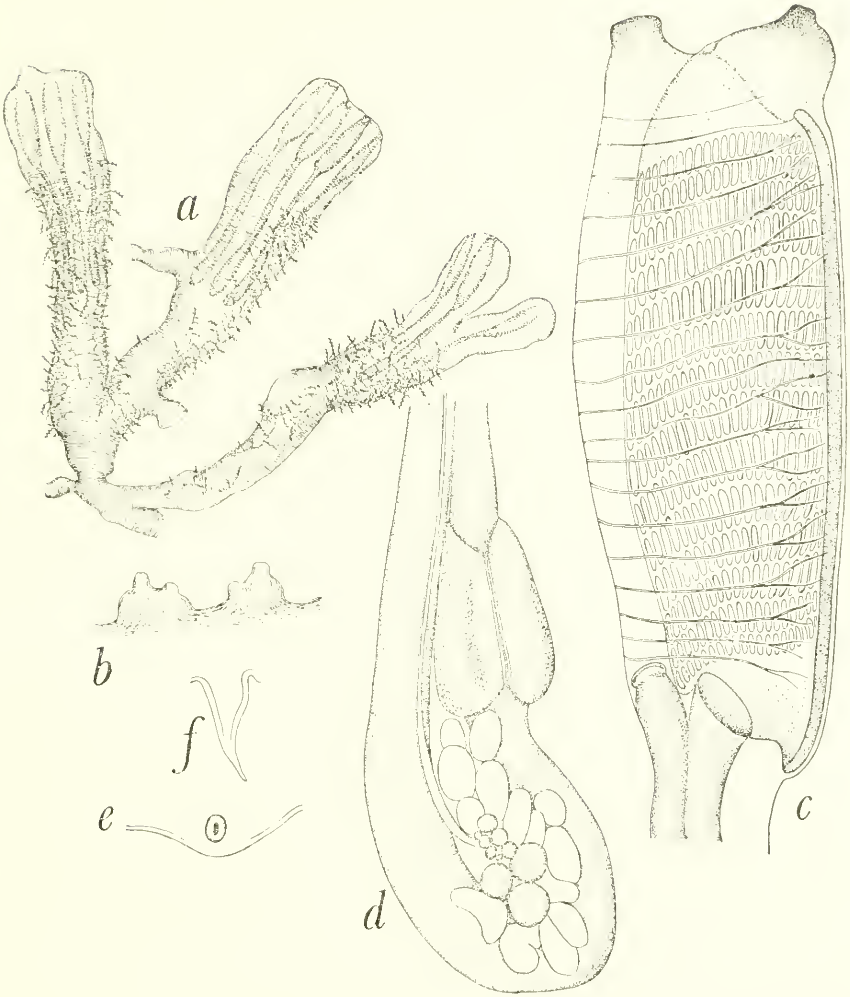

FIGURE 36.—*Clavelina* (*Synclavella*) *arafurensis* Tokioka: *a*, three cormidia of the larger colony; *b*, distal surface of a cormidium showing apertures of two zooids; *c*, right side of thorax; *d*, left siae of abdomen; *e*, ciliated groove; *f*, dorsal languet.

Cormidia attain a maximum length of 32 mm., but are usually 25 mm. in length and 5 mm. in thickness. Number of zooids embedded in respective cormidia varies from 3 to 9, averaging 5 or 6. Zooids arranged with ventral sides towards periphery. Corona soft, slightly milky white, transparent, and contains thoraces and anterior parts of abdomens; peduncular portion yellowish white, rather hard, translucent, frequently covered with foreign material. Anterior portion of zooid slightly protrudes from distal surface of corona, as shown in fig. 36*b*. When animal is alive body dark blue, nearly black, margin of apertures very bright yellow. In preserved specimens, thorax pale purplish brown. Both apertures round in outline. Abdomen 2½ to 3 times as long as thorax. About 20 transverse muscles on each side of thorax, but no longitudinal muscles found. Stigmatal rows 14–15, about 25 stigmata in each row. Ciliated groove an elliptical opening, slightly elongated longitudinally, 16 tentacles arranged as 4 large, 4 medium, 8 small, also minute ones. Dorsal languets large and tongue-shaped, horizontal membranes well developed along respective transverse vessels. Cardiac end of stomach situated approximately at level of posterior third of abdomen. Stomach somewhat elongated in outline, its surface might be smooth, although in present preserved specimens a few plication-like longitudinal folds are faintly seen, very probably due to contraction of the animal. Midintestinal portion quite obscure. Anus bilobed, opens at level of last transverse vessel of branchial sac. About 25 testicular follicles scattered on left side of intestinal loop posterior to stomach. Ovary situated near center of gonad.

DISTRIBUTION.—Formerly known from the Arafura Sea.

46. *Clavelina (Synclavella) gigantea* Van Name

FIGURE 37

Not *Polycitor giganteus* Sluiter, 1919, p. 10, pl. 1, figs. 18–20.

Clavelina gigantea Van Name (part) 1921, p. 358, fig. 40.—Ärnbäck-Christie-Linde, 1925, p. 18.—Van Name, 1945, p. 139, fig. 65; pl. 14, fig. 1; pl. 16, fig. 4.

Clavelina oblonga Van Name (part) 1930, p. 450, fig. 24, figure on right.

MATERIAL EXAMINED

GULF OF MEXICO: Off Dry Tortugas; 25°34′00″ N., 83°07′00″ W., 30 fath.; *Grampus* sta. 5078, March 1, 1889. Two colonies (USNM 11781) on crab, *Dromidia antillensis* Stimpson (USNM 29000).

DESCRIPTION.—As Van Name (1918) states that in colonies of *Clavelina molluccensis* (Sluiter), "not mature and those which appear to have grown under less favorable conditions . . . the zooids are not so completely separate . . ., the anterior part of the zooid only has its own sheath of test, the posterior part being imbedded in a common mass of test," it seems to be necessary to compare *Clavelina molluccensis* with some known species of *Clavelina* (*Synclavella*) and thus a large (60 mm. high and 36 mm. in diameter), pale yellowish gray, nearly roundish massive colony of *Clavelina* (*Synclavella*) *gigantea* Van Name was chosen for this purpose. The colony is carried on the carapace of a dromid crab 22 mm. in carapace length, *Dromidia antillensis* Stimpson, from the West Indies area (crab cat. no. 29000). Also a smaller colony 24 mm. long × 11 mm. wide (USNM 11781), containing only seven zooids, carried on the carapace of an 11 mm. long dromid crab was examined.

Test gelatinous, rather hard, translucent, the surface nearly smooth; both branchial and atrial apertures contracted, sunken respectively to

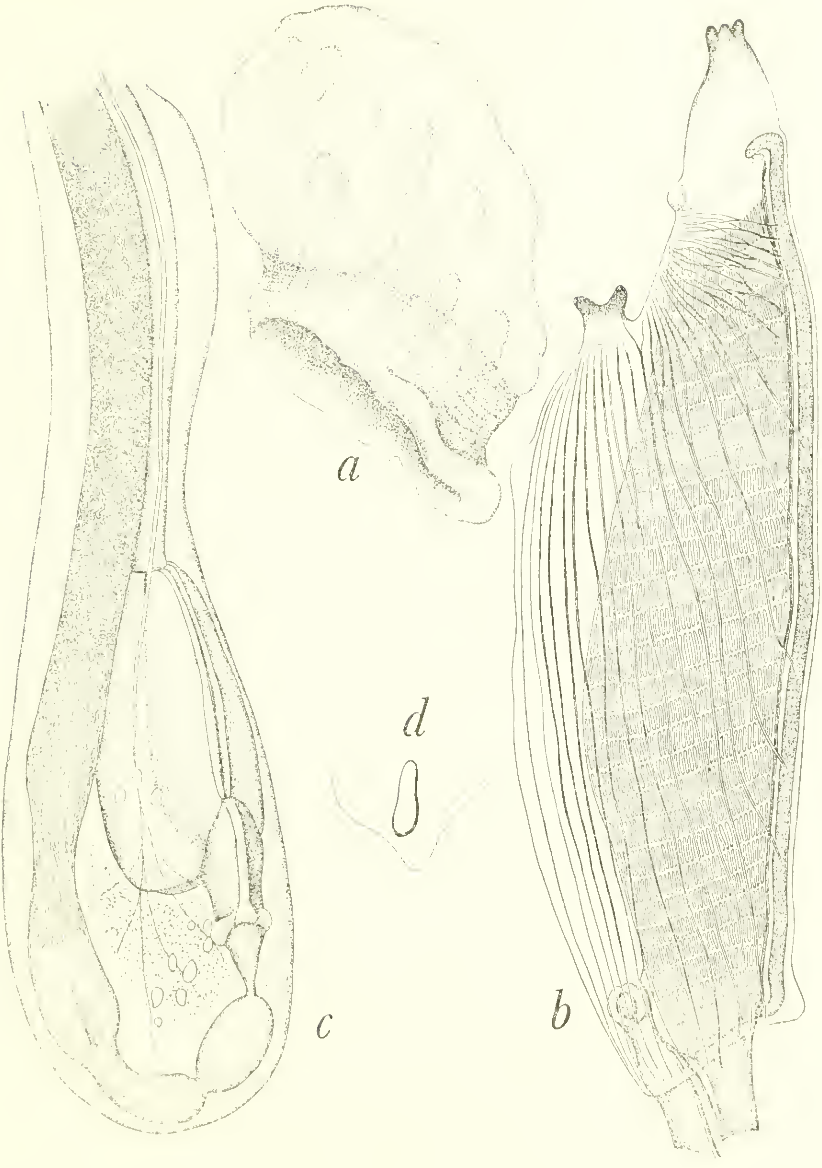

Figure 37.—*Clavelina* (*Synclavella*) *gigantea* Van Name: *a*, larger colony, 60 mm. × 36 mm.; *b*, right side of thorax; *c*, left side of abdomen, testicular follicles removed to show outline of hind stomach and midintestinal portion; *d*, ciliated groove.

bottom of a small pit. Distance between zooids 5–9 mm., 7.5 mm. on an average.

Zooids 14–25 mm. in length. Abdomen nearly as long as thorax or slightly longer. Branchial aperture 6-lobed, each lobe pectinated with 6–12 small prominences; atrial aperture cut into 2 pectinated lobes. Well developed atrial velum present at base of short atrial siphon. About 15 longitudinal muscles on dorsal half of each side of thorax, converging at atrial aperture, dorsal muscles rather fine; about a dozen oblique muscles on ventral half of each side of thorax, converging at dorsomedian line between dorsal ganglion and atrial siphon. A very strong longitudinal muscle running along each side of endostyle. Many fine transverse muscles beneath longitudinal musculature, as many as 80 in larger zoodis. All longitudinal muscles converge posteriorly to a pair of longitudinal muscle bands running down along ventral side of abdomen, the right band is stouter than the left. In zooids examined 22–28 stigmatal rows, about 50 stigmata in each row. Tentacles 32, larger alternate with smaller ones rather regularly; ciliated groove an elongated slit; dorsal languets situated on dorsomedian line. Horizontal membranes well developed along respective transverse vessels. Stomach begins roughly from middle of abdomen, elongate and about a fourth as long as abdomen, with five distinct longitudinal crests besides a typhlosole. Hind stomach and midintestinal portion clearly defined, the latter strongly constricted at middle. A small but distinct depression on each side of proximal portion of rectum. Wall of rectum between level of middle of hind stomach and anterior end of abdomen covered with whitish circumintestinal gland which consists of a number of fine tubules running lineally and parallel to one another near proximal end of rectum, but are very complicatedly entangled on distal parts. Anus bilobed, situated slightly anterior to dorsoposterior corner of thorax; usually four or five stigmatal rows present posterior to the edge of membrane connecting anus with branchial sac. Testicular follicles small, very numerous and distributed on left side of intestinal loop posterior to middle of stomach.

Distribution.—West Indies.

47. *Eudistoma pyriforme* (Herdman)

Figure 38

Psammaplidium pyriforme Herdman, 1886, p. 419.
Eudistoma pyriforme Hastings, 1931, p. 83, fig. 7D.—Tokioka, 1950, p. 120, fig. 4.

MATERIAL EXAMINED

Palau Islands: Madalai district, west end of Koror Island; GVF sta. 12. One specimen (USNM 11402).

Gilbert Islands: Onotoa Atoll; P. E. Cloud, sta. GOC–59. Two small colonies (USNM 11476), attached to underside of *Didemnum* (*D.*) *candidum* Savigny (USNM 11514).

Description.—A single large colony from the Palau Islands was examined. It is roughly roundish in shape, about 55 mm. in diameter and 14 mm. in thickness. It consists of two cormidia, one much smaller than the other. The surface of the colony is nearly smooth and dull purplish brown in alcoholic preservation.

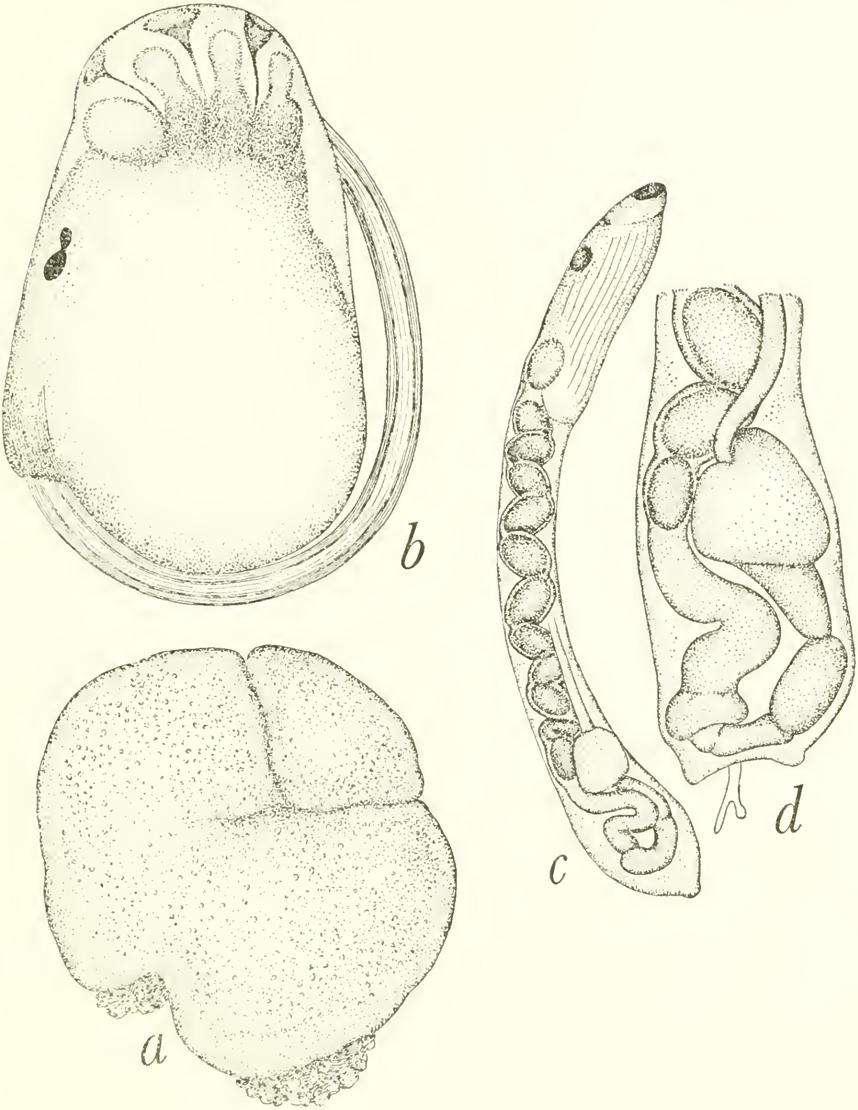

Figure 38.—*Eudistoma pyriforme* (Herdman): *a*, surface of colony from the Palau Islands; *b*, right side of embryo from same colony; *c*, right side of zooid of small young colony from Gilbert Islands; *d*, posterior part of abdomen of same zooid.

Test hard, rather tough to the touch, being impregnated with sand grains. System of zooid arrangement indistinct. Both apertures distinctly 6-lobed. About 20 tentacles, larger and smaller ones defined; dorsal languets finger-shaped.

Larger embryos attain 700μ in length. Three attachment processes arranged lineally, elongate-elliptical when seen from surface. Four pairs of ampullae; two pigment flecks of sensory organ arranged anteroposteriorly.

REMARKS.—The coloration and the surface appearance of the present preserved specimen differ slightly from those of the specimens previously described, which are generally yellowish brown and marked with irregularly formed depressions on the surface. Such differences are probably due to the unequal state of preservation. Two small colonies from the Gilbert Islands (USNM 11476, collected Aug. 27, 1951), found attached to the underside of a colony of *Didemnum* (*Didemnum*) *candidum* Savigny, seem to represent young colonies of the present species. They are respectively 12 mm. × 2 mm. and 4 mm. × 1.5 mm. in extent, extremely thin with zooids all laid horizontally; the smaller colony contains merely two zooids. The test is transparent and contains a few sand grains and fecal pellets within. Even larger zooids are only 2 mm. in length, while most are strongly contracted to 0.5 mm. in length. Zooids are yellowish brown. The thorax occupies one-third of the total length, with about 8 longitudinal and about 30 extremely fine, transverse muscles on each side. The exact number of stigmata in each of three rows cannot be ascertained on examined zooids, although it is not great. Two pairs of longitudinal muscular bands run along the abdomen. The proximal end of the rectum is distinctly constricted from the midintestinal portion, but does not form any caecum. The rectum forms a remarkable crook in the posterior part of the abdomen and this is the very important character upon which the present specimens are identified as *E. pyriforme*.

48. *Eudistoma angolanum* (Michaelsen)

FIGURE 39

Polycitor paesslerioides var. *angolanus* Michaelsen, 1914, p. 430.
Polycitor amplus Hartmeyer, 1919, p. 105, pl. 2, figs. 54–55.
Eudistoma angolanum Hastings, 1931, p. 86, fig. 9.

MATERIAL EXAMINED

MARIANAS ISLANDS: Saipan; P. E. Cloud, sta. D–7. One colony (USNM 11539).—Saipan; P. E. Cloud, sta. D–8. One colony (USNM 11572).

GILBERT ISLANDS: Onotoa Atoll; A. H. Banner, sta. B–8. Three colonies (USNM 11517).—Onotoa Atoll; P. E. Cloud, sta. GOC–28. One colony (USNM 11516).—Onotoa Atoll; P. E. Cloud, sta. GOC–55. Three colonies (USNM 11478).

DESCRIPTION.—Seven colonies from the Gilbert Islands and two from Saipan Island were examined. The largest colony is 40 mm. × 28 mm. in extent and 12 mm. in thickness; another large colony from the Gilbert Islands (USNM 11516) consists of three cormidia, respectively 20 mm. × 15 mm., 15 mm. × 8 mm., and 14 mm. × 11 mm. in extent and 8 mm. in thickness, of which 3–4 mm. constitute the corona. The upper part of the colony or the corona is usually bluish

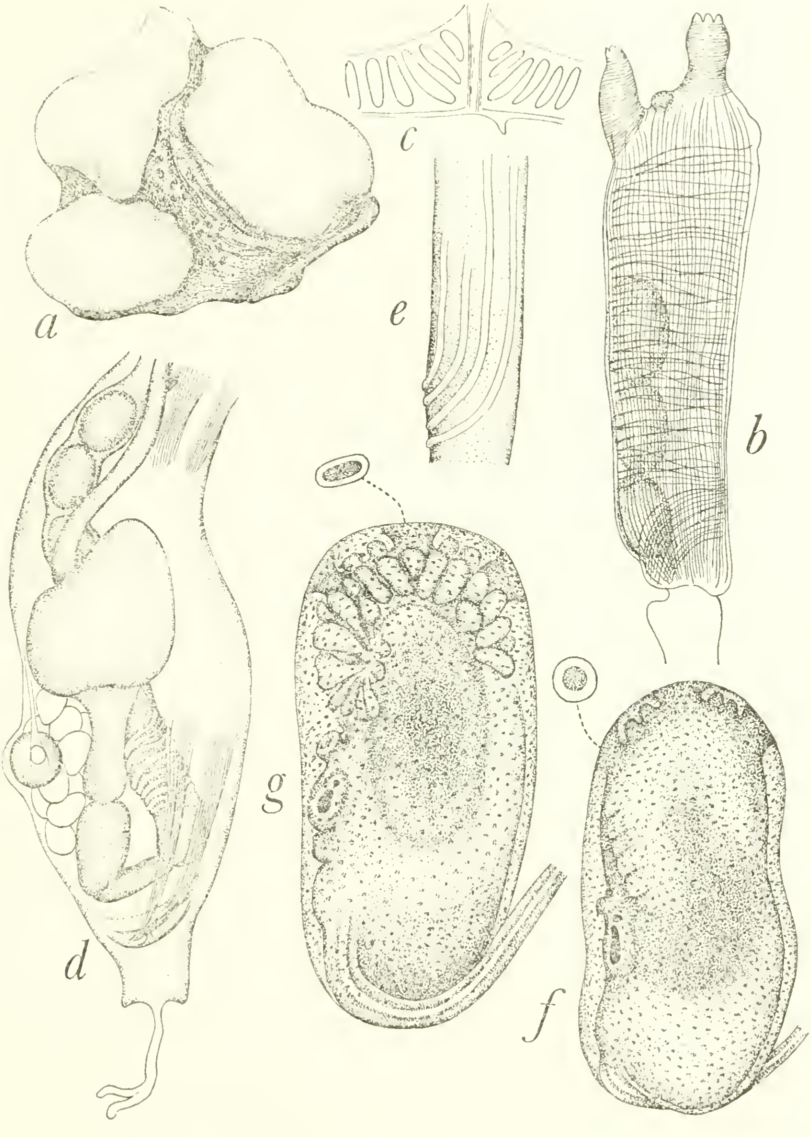

FIGURE 39.—*Eudistoma angolanum* (Michaelsen): *a*, colony from Gilbert Islands, GOC–28; *b*, right side of thorax of a zooid of colony from Saipan Island, D–7; *c*, dorsal part of first stigmatal row, colony from Gilbert Islands, Onotoa, B–8; *d*, abdomen of zooid from same colony; *e*, circumintestinal gland of same zooid; *f*, young embryo (0.8 mm. long) from Saipan Island, D–7, right side; *g*, embryo in advanced stage (1 mm. long) from same colony, right side.

or brownish black, the basal part is a much lighter yellowish or grayish brown. The surface of the colony is free from foreign materials and nearly even, although at some places it is slightly depressed by contraction. The specimen from Saipan Island (USNM 11539), 30 mm. × 19 mm. in extent and 9 mm. in thickness, is encrusted exceptionally densely with sand grains.

Test somewhat hard, gelatinous, translucent, contains in thoracic layer many small, oval pigment masses, bluish, purplish black, or dark olive. Pigment masses may be scattered throughout entire colony in some specimens, but usually are very scarce in abdominal and bottom layers. In thoracic layer, in addition to pigment masses, are many whitish masses of shape and size the same as pigment masses, but containing no pigments. Abdominal and bottom layers and peripheral part of colony contain various amounts of minute sand grains, also some fecal pellets embedded in the bottom layer. Sand grains very sparce or quite absent in thoracic layer. Amount of pigments, sand grains, and fecal pellets embedded in test varies according to colony. In some specimens the thin superficial transparent layer is defined clearly and minute, up to 38μ in diameter, round or oval and milky white structureless bodies, probably secretion products, are scattered on the surface. Zooids at least 4 mm. in length in a strongly contracted state, but may reach 9 mm. in a somewhat extended condition. Thorax occupies a third to about half of entire body length, but may be only a third of the abdomen's length when strongly contracted. Color yellowish orange or reddish brown, probably reddish orange in living animal. No system found in arrangement of zooids. Both apertures 6-lobed, atrial siphon comparatively long. Longitudinal and transverse musculatures well developed on thorax. On each side 10 to 30 longitudinal, 25 to 60 transverse muscles, the latter confined to stigmatal area of thorax, and run beneath former. In some zooids examined, most of about 60 transverse muscles unite on dorsal side into approximately 35 bundles; about 10 posterior ones run obliquely. Several dorsal longitudinal muscles very fine. Posterior part of thorax and anterior part of abdomen sometimes swollen by strong contraction of longtiudinal muscles. A fairly strong but very short retractile muscle may be found at posteroventral corner of thorax in some zooids. From 12 to about 20 stigmata in each of three rows; two or three dorsal ones of first row arranged along dorsomedian line as shown in fig. 39*c*. Tentacles 12–16, also some minute ones; generally larger and smaller ones alternate regularly. Ciliated groove a small oval opening. Dorsal languets slightly displaced to the left side from dorsomedian line. Peripharyngeal band, both sides of anterior part of endostyle and transverse vessels may be purplish brown in some cases. Yellowish or purplish-brown pigments may also be found deposited between stigmata. Two pairs of longitudinal muscle bands run along abdomen and end on right side near posterior end of abdomen. Mantle is sometimes reddish brown. Stomach situated at level of posterior one-fourth of abdomen and smoothly surfaced. Hind stomach and mid-intestine distinct; proximal end of rectum markedly constricted from preceding part, but not forming caecum. Rectum shows no twisting or sharp curving. Anus bilobed, opens at level of second transverse vessel. Circumintestinal gland consists of about a dozen longitudinal tubules extending from level of pyloric end of stomach anteriorly for the distance of 1½ times the stomach length; tubules arranged horizontally across rectum at proximal portion. Testicular follicles vary from one to two dozen and occupy left side of intestinal loop posterior to stomach; ovary situated near center of gonad.

Larvae from 0.8 mm. to 1 mm. in trunk length. Larval test somewhat frothy in appearance. Three attachment processes roundish in outline in younger stages but become elongated in advanced stages. About 50 ampullae found near base of attachment processes in advanced stages. Two pigment flecks of sensory organ arranged obliquely or anteroposteriorly.

REMARKS.—A small piece of colony attached to the surface of a large dead coral came up with the anchor of L.T. 535 at loc. 2 in the lagoon west of Saipan on April 28, 1949, and collected and preserved on May 2, 1949 (cat. no. 11504), seems to belong to the present species, although some doubts remain. It is dried, 6 mm. × 1.5 mm. in extent and very thin. The test is transparent and contains many sand grains embedded within, but only a small number of zooids are included. The stomach is located in the posterior part of the fairly elongated abdomen. This appearance of the zooid and the structure of the test impregnated with sand grains are considered to indicate a close resemblance to those of *E. angolanum.*

48a. *Eudistoma* sp. aff. *angolanum* (Michaelsen)

FIGURE 40

MATERIAL EXAMINED

PALAU ISLANDS: North shore of Koror Island, west of Ebadul's Pier; GVF sta. 60. One colony (USNM 11403).

DESCRIPTION.—A single thick encrusted colony from the Palau Islands was examined. It is 15 mm. × 34 mm. in extent and about 10 mm. in thickness, dark purplish brown or dark brownish.

Test is soft, leathery, thoracic stratum rather soft, whereas abdominal stratum and the bottom layer are hard in consistency and contain fecal pellets. Surface of colony is nearly smooth, quite free from foreign matter; no system of zooid arrangement seen on surface. Zooids brownish, may attain 9–10 mm. in length when extended, as is shown clearly by zooidal hollows in test. Thoraces occupy a third to a fourth of entire body length in an extended state, although all are found contracted in the present specimen. Both apertures 6-lobed, atrial siphon protrudes more anteriorly than branchial siphon in very many examined zooids. Both longitudinal and transverse muscles

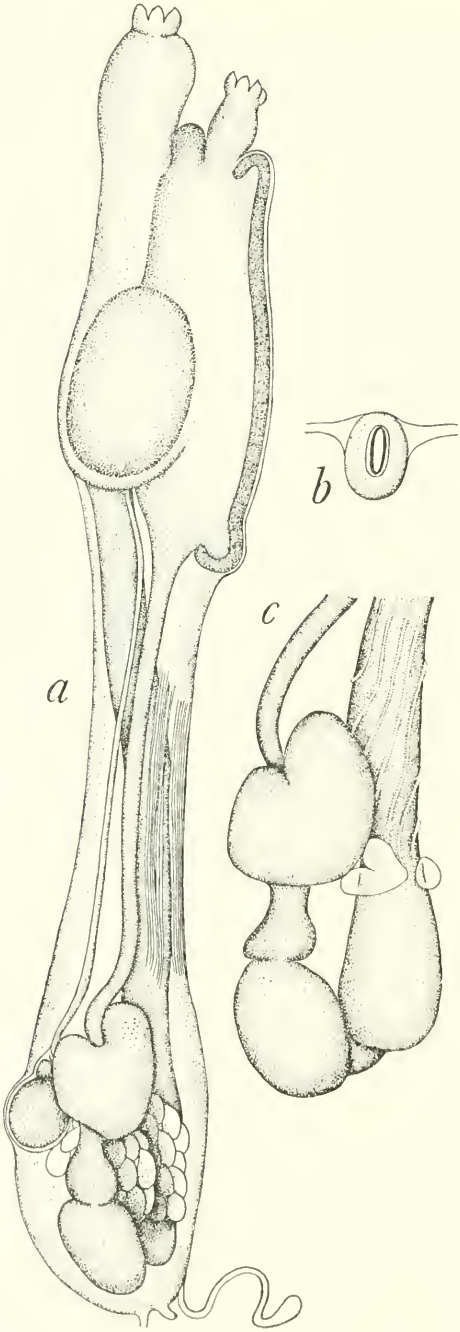

Figure 40.—*Eudistoma* sp. aff. *angolanum* (Michaelsen): *a,* right side of a zooid; *b,* ciliated groove, magnified; *c,* posterior part of intestinal loop.

are well developed on thorax, although exact number of muscles cannot be given here because of strongly contracted state of specimen. Longitudinal muscles go onto abdomen being united into two pairs of longitudinal muscle bands. About 10 stigmata in each of three rows; many yellowish corpuscles found deposited between the stigmata, probably branchial sac orange red when the animal was alive. About 20 tentacles, ciliated groove elliptical and situated longitudinally, dorsal languets tongue-shaped. Hind stomach and midintestine well defined, about 1½ times the length of stomach when measured together. Proximal end of rectum constricted markedly from midintestine, but no caeca formed there. Circumintestinal gland consists of about a dozen fine tubules extending from level of pyloric end of stomach anteriorly for a distance of about twice as long as stomach. Two vesicles, one much larger, beside rectum at proximal portion of circumintestinal gland. Anus bilobed, opens at level of second transverse vessel. Ovary situated on left side of intestinal loop near level of pyloric end of stomach. Testicular follicles, 12–29 in examined zooids, crowded inside intestinal loop posterior to middle of stomach and divided into dorsal and ventral groups, dorsal group usually larger than ventral. This feature can be easily seen on right side of loop. Usually one or two embryos found in incubatory chamber.

REMARKS.—The appearance of the present colony superficially resembles *Eudistoma rigida* Tokioka, but the color and hardness of the test differ distinctly between these two forms. Moreover, the range of the tubular circumintestinal gland is much narrower in *E. rigida* than in the present specimen. *Eudistoma snakabri* Tokioka also resembles the present form in the general structure of zooid, although the shape of the stomach differs considerably. Also the colony of the former carries sand grains over the surface and contains them within the test. *Eudistoma angolanum* (Michaelsen) shows a very close resemblance to the present specimen in the structure of zooid, although the colony carries foreign matter within the test, sparsely in the upper layer, and more densely in the bottom layer. Thus, it is very possible that the present colony may represent an unusual state of *E. angolanum*, in which sand grains are missing within the test due to some unknown cause.

49. *Eudistoma rubrum* Tokioka

FIGURE 41*b*

Eudistoma rubra Tokioka, 1954a, p. 252, fig. 2; pl. 28, figs. 2–6.

MATERIAL EXAMINED

GILBERT ISLANDS: Onotoa Atoll; P. E. Cloud, sta. GOC–55. One colony (USNM 11477).

DESCRIPTION.—There is some doubt of the present identification. A single roughly cylindrical colony attached to the substratum somewhat obliquely was examined. It is 12 mm. long, 8 mm. in diameter and 4 mm. in height. The basal peduncular portion is milky white, with distal corona faintly brownish violet.

Test soft, gelatinous, and translucent; containing fine sand grains and fecal pellets at proximal part of peduncle. Zooids so strongly contracted that they are only 3.8 mm. in length at maximum. Both apertures 6-lobed. Thorax faintly purplish brown; approximately 10 longitudinal muscles on each side, but without distinct transverse muscles. Three stigmatal rows present, exact number of stigmata in each row not clear because of strongly contracted state. Stomach wall smooth, proximal portion of rectum distinctly constricted from middle intestinal portion, but forming no caecum there.

50. *?Eudistoma tokarae* Tokioka

FIGURE 41*c*

Eudistoma tokarae Tokioka, 1954a, p. 254, pl. 29, figs. 1–2.

MATERIAL EXAMINED

PHILIPPINE ISLANDS: Baliwasan; W. R. Taylor, sta. 10. One colony (USNM 11655).

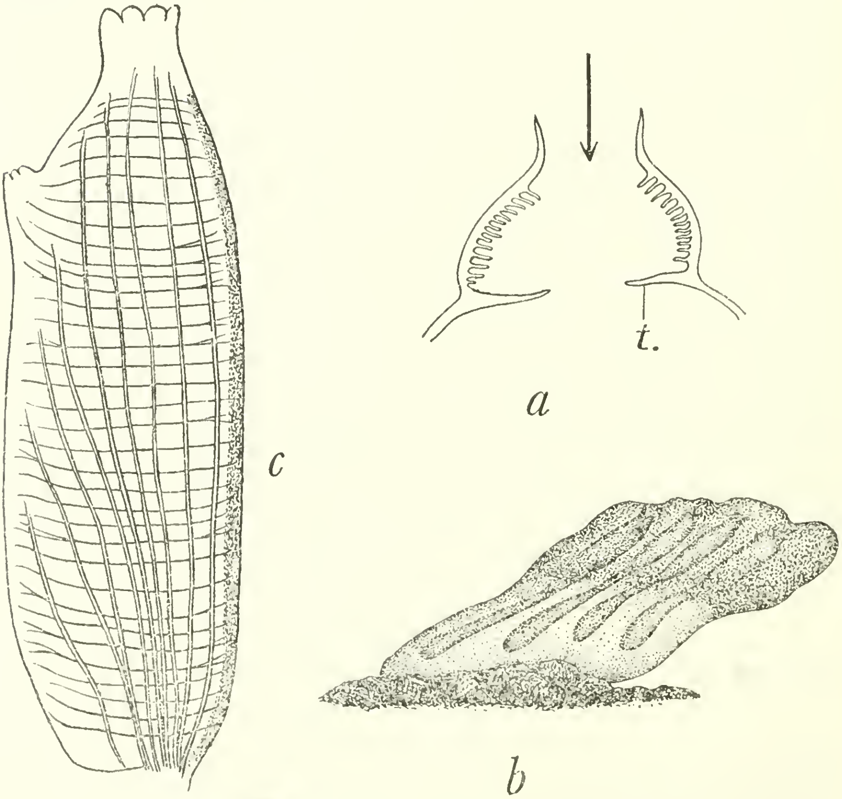

FIGURE 41.—*a*, *Eudistoma amplum* (Sluiter): section of the branchial siphon (t.= tentacle). *b*, *Eudistoma rubrum* Tokioka: 12 mm. long colony from the Gilbert Islands. *c*, *?Eudistoma tokarae* Tokioka: right side of thorax from the 20 mm. long Philippine colony.

DESCRIPTION.—A single, elongated, cylindrical colony from the Philippines, 20 mm. long and about 3 mm. thick, densely encrusted with sand grains on the surface, was examined.

Zooids about 5 mm. in length, abdomen two to three times as long as contracted thorax. About 8 longitudinal and about 30 fine transverse muscles on each side of thorax; about 10 stigmata in each of three rows.

REMARKS.—Longitudinal and transverse thoracic muscles of the present form number as many as in *Eudistoma tokarae*, but considerably fewer than in *E. snakabri* Tokioka in which 20–35 longitudinal muscles and up to 65 transverse muscles are defined. On the other hand, the appearance of the colony closely resembles that of *E. snakabri*, being densely encrusted with sand grains all over the surface. Thus, it is not impossible that the present specimen represents a young colony of *E. snakabri*, including zooids having fewer muscles. However it seems more reasonable to treat the present specimen as an unusual colony of *E. tokarae*, which is carrying sand grains on the surface.

51. *Eudistoma laysani* (Sluiter)

FIGURE 42

Distoma laysani Sluiter, 1900, p. 9, pl. 1, fig. 2; pl. 2, fig. 7.
Polycitor laysani Sluiter, 1909, p. 4.

MATERIAL EXAMINED

PALAU ISLANDS: Madalai district, west end of Koror Island; GVF sta. 12. One colony (USNM 11401).

DESCRIPTION.—A single colony from the Palau Islands consisting of 13 cormidia and a large common basal mass which is 50 mm. × 19 mm. in extent and 23 mm. in thickness was examined.

Cormidia all exposed, somewhat irregularly shaped, some divided distally into two tips; the largest 12 mm. long and 8 mm. in diameter. Basal mass generally purplish gray, and at basal parts contains many fecal pellets which add a brownish-yellow tint. Upper surface of basal mass covered with mud and small algae between cormidia. Test soft, but tough and opaque. Zooids very long. Thoraces embedded in corona of cormidium, about 1 mm. long in a contracted state; faintly purplish brown. Abdomens much longer, up to 15 mm., embedded deeply in basal mass. Probably posterior part of abdomen containing gonads and stomach was orange red in living animal. Both apertures 6-lobed, atrial siphon always smaller and situated somewhat posteriorly to branchial siphon. About 20 (22 for example) longitudinal and 40–50 very fine transverse muscles on each side of thorax. Longitudinal muscles run onto abdomen, but are not united into muscular bands at neck region; transverse muscles confined to stigmatal area. About 15 stigmata in each of three rows; a few dorsal stigmata of the first row arranged along dorsomedian line. Dorsal languets distinct,

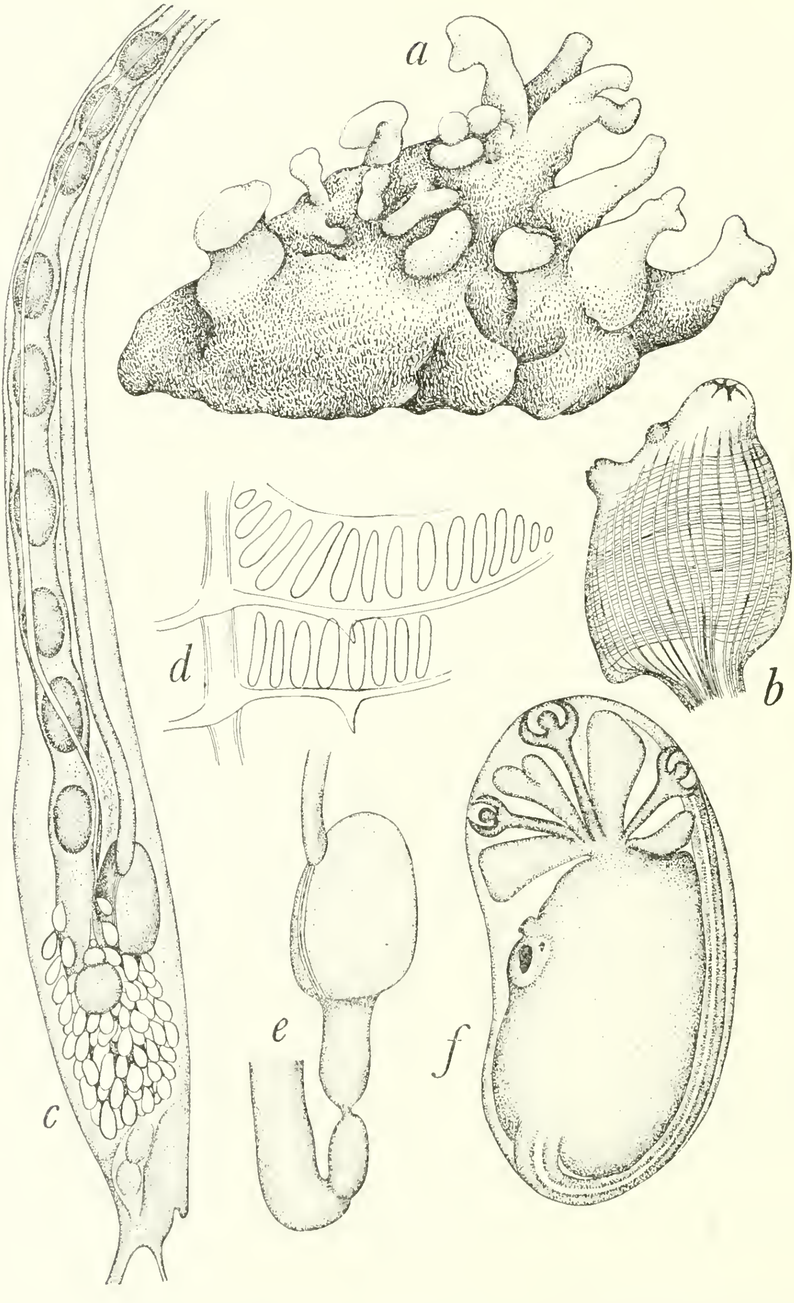

FIGURE 42.—*Eudistoma laysani* (Sluiter): *a*, colony from the Palau Islands; *b*, right side of thorax; *c*, right side of abdomen; *d*, first and second stigmatal rows on left side; *e*, stomach, hind stomach, and midintestine; *f*, embryo, right side.

finger-shaped and situated on left side displaced from dorsomedian line for distance of approximately four stigmata. Tentacles 16(?) in an examined zooid, exact number very difficult to determine. Ciliated groove a small oval opening. Stomach smoothly surfaced, situated very near posterior end of abdomen. Hind stomach as long as stomach; middle intestine whitish and separated by a slight constriction from proximal end of rectum, which is slightly salmon pinkish; no caecum formed at proximal portion of rectum. Rectum runs straight to anus which is distinctly bilobed and opens at level of second transverse vessel. Ovary situated at level of anterior half of hind stomach. Testicular follicles very numerous, up to 83 in an examined zooid, spread over posterior half of stomach and left side of intestinal loop; they extend to right side of intestinal loop or slightly beyond rear end of loop when fully matured. One or two embryos found in incubatory chamber. Some zooids infested at genital portion by parasitic copepods.

Larvae elliptical and about 1 mm. in trunk length. Three attachment processes cup-shaped, roundish in outline on surface and arranged lineally. Pigment flecks of sensory organ arranged obliquely.

REMARKS.—The present specimen closely resembles *Eudistoma olivaceus* (Van Name) in the appearance of the colony, but differs in the number of stigmata in each row and in the number of transverse muscles on the thorax. *E. olivaceus* has about 25 stigmata, or more, in a row on each side, but with approximately 10 transverse muscles on the thorax.

52. *Eudistoma amplum* (Sluiter)

FIGURE 41*a*

Polycitor amplus Sluiter, 1909, p. 21, pl. 2, fig. 3; pl. 6, fig. 4.
Eudistoma amplus Tokioka, 1950, p. 118, fig. 3.

MATERIAL EXAMINED

PALAU ISLANDS: Iwayama Bay, south end of Island XV; GVF sta. 92A. One colony (USNM 11407).—Iwayama Bay, east side of Oyster Pass; GVF sta. 220. One colony (USNM 11413).

DESCRIPTION.—Two large colonies from the Palau Islands, 70 mm. × 45 mm. and 120 mm. × 40 mm. in extent and 10–16 mm. in thickness, grayish olive brown in color, were examined. Test shows characteristic structure containing many large bladder cells or capsules. Stellate systems very distinct. Longitudinal muscles 20–25 on each side of thorax. Besides ordinary tentacles, many minute tentacular prominences are densely set on inner surface of proximal half of branchial siphon, making it hardly possible to count tentacles exactly in contracted zooids.

53. *Eudistoma viride* Tokioka

Eudistoma viridis Tokioka, 1955b, p. 49, pl. 4, figs. 1–5.

MATERIAL EXAMINED

PALAU ISLANDS: Barrier reef 8 mi. NW. of Koror Island; GVF sta. 25. Five colonies attached to reef coral debris (USNM 11389).—Ngaremdiu, eastern side of Urukthapel; GVF sta. 53. One colony (USNM 11457).—Fringing reef of small island in lagoon (Meharehar) of Eil Malk; GVF sta. 252. Ten colonies (USNM 11430), attached to basal part of *Polycarpa cryptocarpa* Sluiter (USNM 11433).

DESCRIPTION.—Sixteen colonies from the Palau Islands were examined; larger ones are 15 mm. × 8 mm. in extent or 23 mm. in length and about 5 mm. in thickness or height. Test translucent and grayish green. Zooids deep green, especially dark at siphonal region of thorax and near area where stomach is situated in abdomen. Stigmata 25–30 in each of three rows.

54. *Eudistoma marianense*, new species

FIGURE 43

HOLOTYPE.—USNM 11470: Marianas Islands; entrance of Tanapag Harbor, lagoon west of Saipan; 36–42 feet; patch of dead coral-algal rock on very coarse-grained limesand bottom; P. E. Cloud, sta. D–8, May 13, 1949.

PARATYPE.—USNM 11810: same data.

DESCRIPTION.—Two colonies are described from Saipan Island, the holotype, 12 mm. × 8 mm., and the paratype, 7 mm. × 4 mm. in extent, and 4–7 mm. in height. They are roughly oval in outline, upper surface nearly even and smooth. Test soft, gelatinous, translucent, milky white, free from foreign matter. No sand grains embedded within tissue, but some fecal pellets are contained in lacunae system and are seen from surface through test. Zooids strongly contracted, in an imperfectly preserved condition; color completely faded. Largest of examined zooids 5 mm. in length, thorax occupies one-third of total length. Both apertures 6-lobed, atrial siphon fairly long. About 10 longitudinal and about 25 transverse muscles on each side. Tentacles 16, larger and smaller ones. Ciliated groove a short longitudinal slit. About a dozen (?) stigmata in each of three rows. Stomach located near middle of abdomen, both hind stomach and midintestine are distinct. Proximal end of rectum is constricted from midintestine, but no caecum formed there. Testicular follicles as many as 19 in examined zooids, spread over left side of intestinal loop posterior to pyloric end of stomach.

Trunk of larvae elongated, 1.5 mm. in examined samples. Three attachment processes elongate-oval in outline, arranged lineally. One median prominence between dorsal and middle attachment processes, two between middle and ventral ones. Two pigment flecks of sensory organ are arranged obliquely and situated at level of approximately one-third of body length from posterior end.

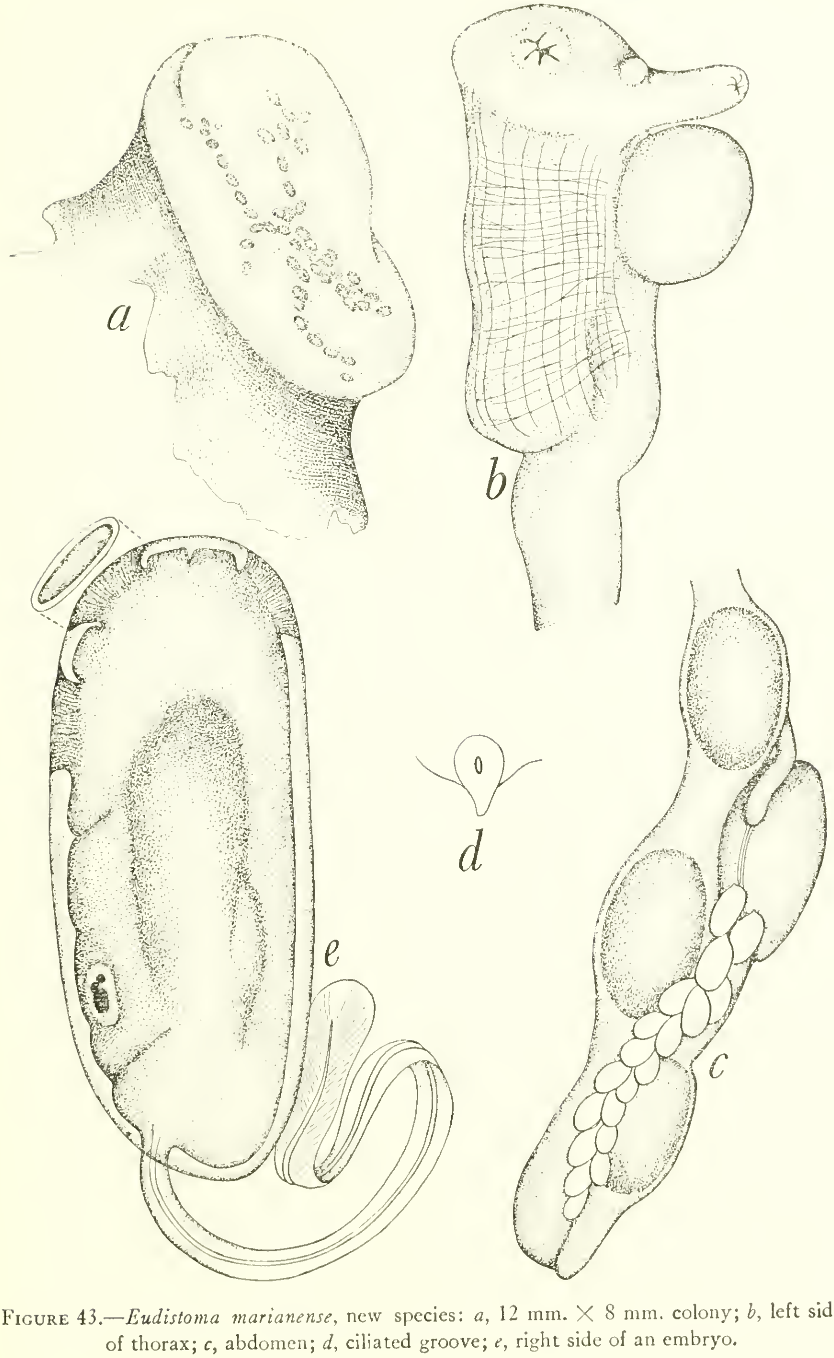

Figure 43.—*Eudistoma marianense*, new species: *a*, 12 mm. × 8 mm. colony; *b*, left side of thorax; *c*, abdomen; *d*, ciliated groove; *e*, right side of an embryo.

55. *Eudistoma albatrossae*, new species

FIGURE 44

HOLOTYPE.—USNM 11811: Japan; off Omai Zaki Light, Honshu, N. 17° E., 9.7 mi.; 34–37 fath., mud, gravel and rock; *Albatross* sta. 3730, May 16, 1900.

PARATYPE.—USNM 11812: same data.

DESCRIPTION.—Two colonies dredged near Japan in the western Pacific were examined, each consisting of a roundish corona and an elongated peduncle attached to a mass of sponges. One specimen (fig. 44*a*) has a comparatively large corona, 17.5 mm. in length and 14 mm. in diameter, and a stout peduncle, 24 mm. long and 8.5 mm. thick; in the other colony, the corona is nearly spherical and very small, only 7.5 mm. long, and the peduncle is longer and much thinner than in the former, 38 mm. long and less than 5 mm. in diameter.

Test faintly whitish yellow, very soft at corona, but hard, gelatinous, or rather cartilaginous and translucent at other portions. Surface of test smooth, although some foreign matter found on peduncle. No system found in arrangement of zooids. Largest zooid examined is 4 mm. in length. Abdomen approximately 2½ times as long as contracted thorax. In smaller colony all zooids found in resting stage, generally 2 mm. in length, constituted of abdomen and rudimentary thorax, but never provided with a fully developed thorax. Both apertures 6-lobed, about 8 longitudinal muscles on each side of thorax. About a dozen (?) stigmata in each of three rows. Tentacles about 8 (?), ciliated groove a small oval opening. Rudimentary thoraces of zooids found in smaller colony attain one-fifth of abdomen's length. Cardiac end of stomach situated approximately at level of posterior one-third of abdomen. Hind stomach very stout, midintestinal portion rather long; proximal end of rectum slightly constricted from preceding part of alimentary canal, but never forming a caecum there. Two pairs of longitudinal muscular bands run along abdomen. In zooids of smaller colony in resting stage alimentary canal wholly embedded in thick mesenchyme tissue. Stomach occupies anterior half of abdomen, both hind stomach and middle intestine are well defined, although boundary between stomach and hind stomach becomes somewhat obscure in some zooids. Middle intestine much longer than hind stomach and markedly constricted near middle. Proximal end of the rectum does not form a caecum. Rectum is generally thin. Gonads not found in any examined zooids.

Hypodistoma, new genus

TYPE SPECIES: *Distoma deerrata* Sluiter, 1895, from Thursday Island.

The atrial aperture of respective zooids opens to the lacunae system of the colony, which is then connected to the exterior through common cloacal apertures. The atrial siphon issues from the dorsoposterior part of the thorax. Other structures are the same as in *Eudistoma*.

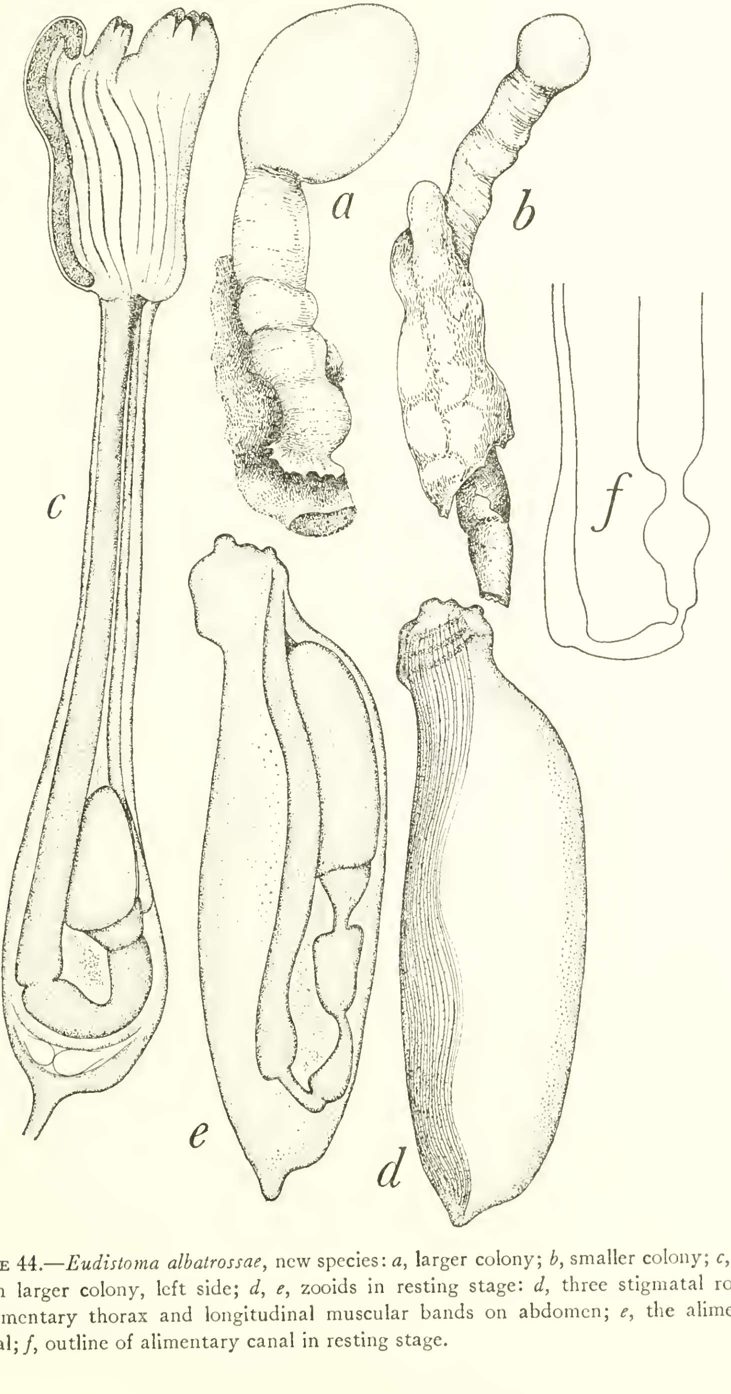

Figure 44.—*Eudistoma albatrossae*, new species: *a*, larger colony; *b*, smaller colony; *c*, zooid from larger colony, left side; *d*, *e*, zooids in resting stage: *d*, three stigmatal rows in rudimentary thorax and longitudinal muscular bands on abdomen; *e*, the alimentary canal; *f*, outline of alimentary canal in resting stage.

56. *Hypodistoma vastum* (Millar)

FIGURE 45

Sigillina vasta Millar, 1962, p. 153, fig. 10.

MATERIAL EXAMINED

PALAU ISLANDS: Iwayama Bay, on east side of Kaki-suido (Oyster Pass) between Island XXIX and east end of Koror Island: 7°18′57″ N., 134°30′09″ E. (HO chart 6076, 2nd ed.); 3–20 ft., limestone with living and dead coral. GVF sta. 220A, October 22, 1955. On *Dromidia undentata* (Rüppell) (USNM 11414).

DESCRIPTION.—A single large colony is described, 80 mm. × 75 mm. in extent and 50 mm. in height, dark purplish brown and roughly hemispherical. It was carried on the carapace of a dromid crab, *Dromidia undentata* (Rüppell) (fide Fenner A. Chace), about 30 mm. in length.

Colony surface generally smooth; many branchial apertures scattered over surface; about 20 common cloacal apertures, roundish or elliptical in outline and up to 8 mm. in long diameter, distributed along periphery on underside or on posterior part (held on posterior side of crab) of colony. Well-developed hypothoracic lacunae under thoracic layer about 2 mm. in thickness. Lacunae may be 3 mm. in height; inner surface very smooth and glistening like soft blackish leather, wall rather hard in consistency. Atrial apertures of zooids open on side wall or on ceiling of lacunae. Abdominal and bottom layers very thick. Test somewhat coarse in consistency, purplish black. No system found in arrangement of zooids. When alive colony pale brown with slightly purplish tint and test very soft to touch, as lacunae were fully expanded. Largest examined zooid 9 mm. in length, 2.5 mm. consisted of thorax. Branchial aperture 6-lobed, located at anterior end of thorax. Atrial aperture also 6-lobed and opens at tip of atrial siphon which issues from dorsoposterior corner of thorax at level of third stigmatal row and usually reaches anteriorly to level of middle of first stigmatal row, at maximum even to level of dorsal ganglion. From 15–20 longitudinal muscles on each side of thorax continued onto abdomen as two pairs of longitudinal muscular bands running along ventral side. About 35 transverse muscles confined to stigmatal area, also 5 others near middle of spacious intermediate area between peripharyngeal band and first stigmatal row; this area as wide as first stigmatal row. Atrial siphon encircled with a number of fine circular muscles, but quite devoid of longitudinal muscles. Approximately 25 elongated stigmata in each of three rows. Horizontal membrane well developed along transverse vessel. Tentacles 12, larger and smaller ones alternate regularly. Ciliated groove a small oval opening. Dorsal languets displaced from dorsomedian line to left side for the distance of about four stigmata. Anus bilobed, opens at level of second transverse vessel. Outline of incubatory chamber seen clearly at dorsoposterior portion of thorax

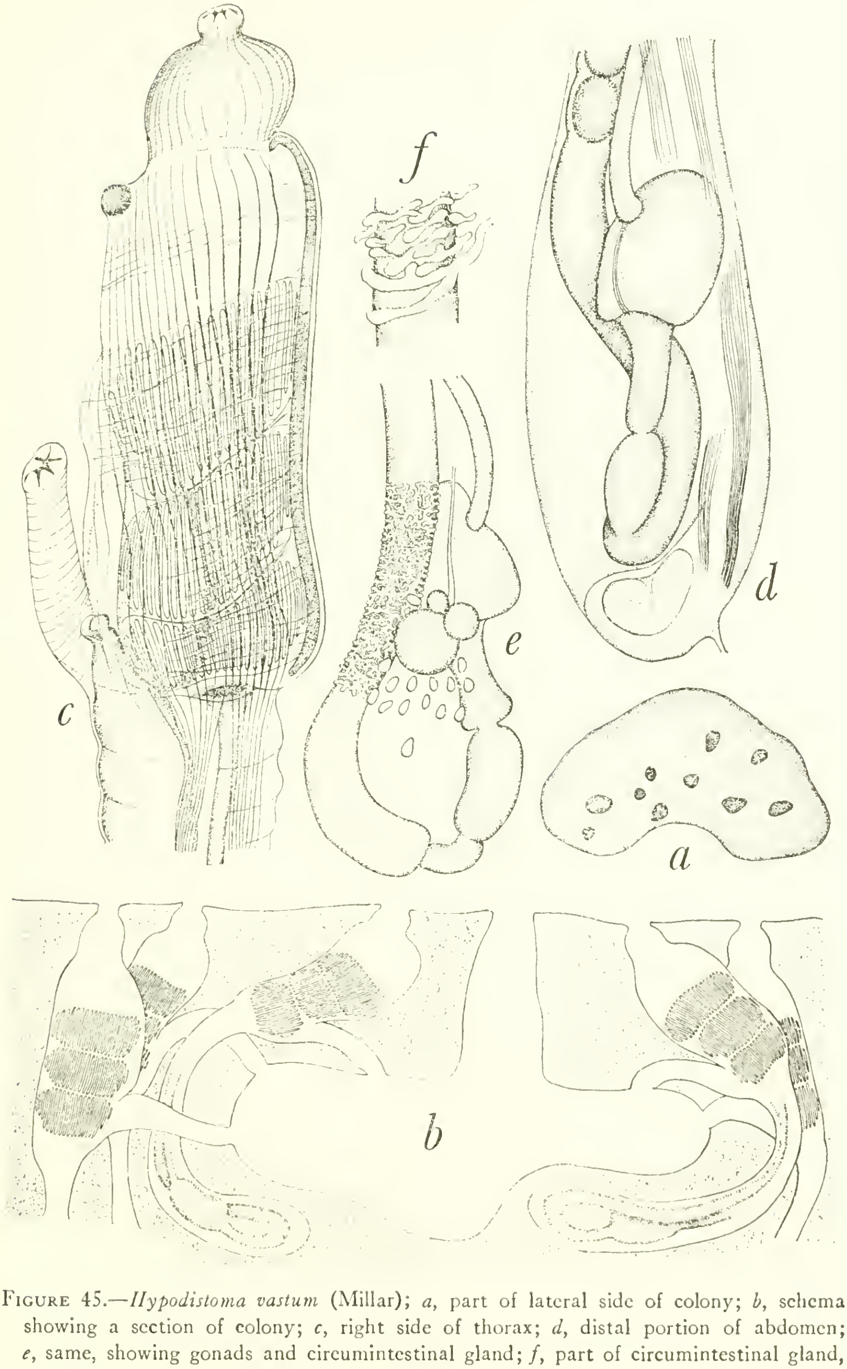

Figure 45.—*Hypodistoma vastum* (Millar); *a*, part of lateral side of colony; *b*, schema showing a section of colony; *c*, right side of thorax; *d*, distal portion of abdomen; *e*, same, showing gonads and circumintestinal gland; *f*, part of circumintestinal gland, magnified.

on right side; chamber empty in all examined zooids. Thoracic mantle light purplish brown; anterior part of thorax, areas along endostyle and around its posterior end pigmented more darkly; tentacles, peripharyngeal band, and transverse vessels pigmented rather heavily.

Stomach situated at level of posterior one-fourth of abdomen. Hind stomach and midintestinal portion well defined. Proximal end of rectum constricted markedly from preceding part of alimentary canal, but no caecum formed. Wall of rectum between level of middle of hind stomach and that of cardiac end of stomach somewhat whitish, due to circumintestinal gland consisting of many fine tubules running very irregularly and complicatedly. Testicular follicles small, not numerous in all examined zooids (which may not yet have fully matured). Ovary located at level between pyloric end of stomach and middle of hind stomach.

Remarks.—The existence of common cloacal apertures on the colony surface and the opening of atrial apertures on the inner surface of the hypothoracic lacunae allude to the close relationship between the present specimen and *Distoma deerrata* Sluiter, 1895, and *Polycitor coalitus* Sluiter, 1909. In the latter two species, however, the abdomen is rather short, roughly as long as the thorax and with no spacious intermediate area between the peripharyngeal band and the first stigmatal row. Stigmata 12 to 13 in each of three rows in *P. coalitus* and only 4 in *D. deerrata;* in the latter rudimentary stigmatal row is at the posterior end of the branchial sac, consisting of 3 to 4 roundish orifices. Zooids of both *Polycitor torosus* Sluiter, 1909, and *P. ianthinus* Sluiter, 1909, closely resemble those of the present specimen in having an atrial siphon issuing from the posterodorsal corner of the thorax. In these two species, however, the atrial aperture opens directly to the exterior on the surface of colony; the lacunae and the common cloacal apertures are never formed. There are 12–18 (up to 20 according to Van Name, 1918) stigmata in each of three rows in *P. torosus* and 10–12 (up to 20 according to Van Name, 1918) in *P. ianthinus.* In the latter, a spacious intermediate area is between the peripharyngeal band and the first stigmatal row as in the present specimen, whereas it is absent in *P. torosus.* The atrial siphon of *P. ianthinus* is provided with a longitudinal musculature. Thus, it is evident that the present specimen forms, together with *D. deerrata* and *P. coalitus*, a peculiar group characterized by the existence of the lacunae system in the colony and resulting in common cloacal apertures, while *P. ianthinus* and *P. torosus* represent an intermediate state between the forms of this group and many other forms belonging to the common *Eudistoma*-type.

57. *Distaplia mikropnoa* (Sluiter)

FIGURE 46

Polyclinum mikropnous Sluiter, 1909, p. 94, pl. 5, fig. 1.
Distaplia mikropnoa Tokioka, 1955b, p. 51, fig. 2; pl. 5, figs. 11–16.

MATERIAL EXAMINED

PALAU ISLANDS: 1¾ mi. NE. of Ngabadangel ("Gabadaguru"); GVF sta. 125. Five colonies (USNM 11436) and one small colony (USNM 11437).

DESCRIPTION.—Six colonies are in the material from the Palau Islands. They are all fungiform, consisting of a roundish or ovoid corona containing zooids within, and a peduncular portion including fascicular vessels, and is attached to fragments of reef corals by the basal end of the peduncular portion. The largest colony is 33 mm. in length, the upper half of the colony is occupied by corona; the peduncle is thinner than the corona, the diameter may be less than half of that of the corona.

Coronal test gelatinous, transparent, yellowish white or dark brownish, very soft in consistency; rarely carries a small amount of fine sand grains or mud on the surface, or within the test. Peduncular test rather hard, translucent, pale brownish; surface generally exposed although small sponges or egg masses of some invertebrates are sometimes attached. Although system of zooid arrangement is obscure, with some difficulty it is found to be somewhat like that in *Sycozoa*. In larger coronae, zooids arranged roughly in paired longitudinal rows, up to 9 pairs in examined colonies. About 10 mature zooids in each of paired rows, arranged in zigzag-fashion. Some minute oval bodies in test of peduncle, usually quite structureless; probably vestiges of buried fecal pellets.

Zooids 2 mm. to 5 mm. in length excluding postabdomen. Abdomen situated nearly perpendicularly, 1½ times as long as contracted thorax. Postabdomen is shorter than abdomen, usually less than two-thirds of length of abdomen; issues from right posterodorsal part of abdomen. Branchial aperture faintly cut into 6 lobes, atrial aperture a huge opening with well-developed atrial languet. About 15 longitudinal muscles on each side of thorax. Approximately a dozen stigmata in each of four rows. Parastigmatic vessels not found in any examined zooids. Larger tentacles 6, also smaller ones; dorsal languets very long and slightly displaced to left side from dorsomedian line. Ciliated groove a minute oval opening. Neck region of abdomen rather short, stomach situated in anterior half of abdomen. Surface of stomach marked with about 20 longitudinal plications; in some zooids surface looks quite smooth, but longitudinal plications of inner wall can be seen clearly. Hind stomach distinct, while midintestinal portion obscure in many zooids or defined very faintly in some. In latter case, short midintestine separable from following rectum by slight lateral depressions at level A shown in figure 46*b* and colored

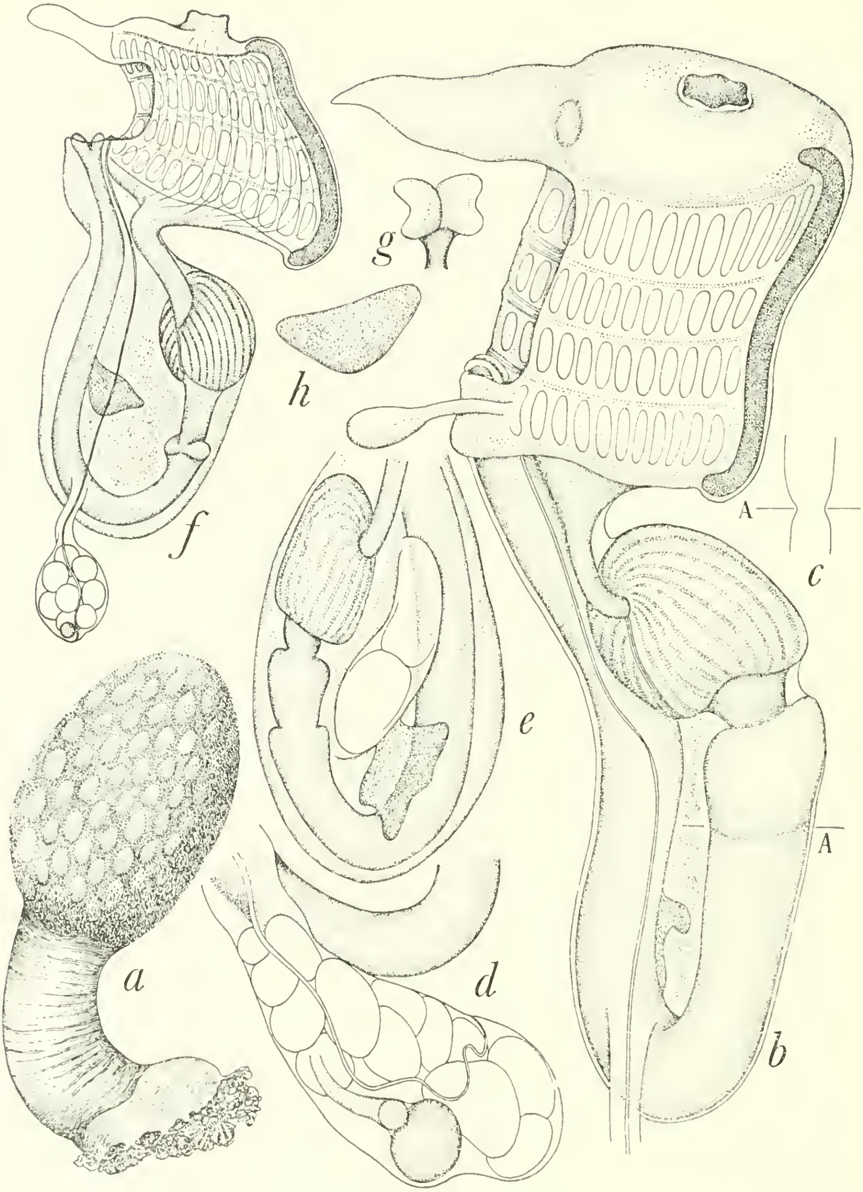

FIGURE 46.—*Distaplia mikropnoa* (Sluiter): *a*, The 33 mm. colony from sta. 125–1189; *b*, right side of a zooid from same colony; *c*, longitudinal section of intestine at level of A, in *b*; *d*, postabdomen of same zooid; *e*, left side of intestinal loop of same zooid; *f*, right side of a zooid from small 10 mm. colony from sta. 125–1187; *g*, anus of same zooid; *h*. circumintestinal gland (?) of same zooid.

differently; middle intestine pinkish, while proximal part of the rectum somewhat yellowish. Anus bilobed, opens at posterodorsal corner of thorax. A triangular or roughly quadrate whitish and opaque tissue of moderate size, probably the circumintestinal gland, found in intestinal loop by rectum at level posterior to pyloric end of the stomach. Testicular follices 13–16; ovary located posterior to middle of postabdomen.

Larvae very large, up to 1.4 mm. in length. Three attachment processes disc-shaped and arranged in a triangle, their basal portions remarkably swollen. Alimentary organ situated on ventral side of trunk nearly at middle. Two pigment flecks of sensory organ arranged dorsoventrally. These structures conform well to those described previously (Tokioka, 1955) on specimens from the Palau Islands.

Remarks.—The present colonies differ remarkably from those described by Sluiter (1909) or Tokioka (1955) in that they are all provided with peduncular portion. Sluiter's original specimen is a large 40 mm. × 60 mm. spongelike mass, varying in thickness from 5 mm. to 8 mm., and Tokioka's specimens are much smaller, being less than 20 mm. × 40 mm. in extent; they are all devoid of the peduncular portion, except a small 13 mm. long colony from the Palau Islands, which has a peduncle-like portion as shown in Tokioka's paper (pl. 5, fig. 15). As the structures of zooids in the present colonies are exactly the same as those previously described on the Palau specimens, I am inclined to consider the present colonies identical with *D. mikropnoa*. Very probably the pedunculate appearance of the present specimens may be attributable to a special environmental condition, perhaps they might have grown in some narrow spaces, such as crevices or among coral fragments.

58. *Distaplia cylindrica* (Lesson) forma *typica*

Figure 47

Holozoa cylindrica Lesson, 1830, p. 439.

Holozoa cylindrica f. *typica* Ärnbäck-Christie-Linde, 1950, p. 33, figs. 9–10; pl. 6, figs. 29–30.

MATERIAL EXAMINED

Antarctica: Off Knox Coast; caught at surface of ocean, nos. 106 and 107. U.S. Navy Antarctic Expedition, coll. Mr. Layton, January 19, 1948. Three colonies (USNM 11786).

Description.—Three ropelike colonies are in the collection, 134 cm., 115 cm., and 57 cm. in length, while the width never reaches beyond 30–40 mm. Colonies are all rather flattened and seem to be in an imperfect condition, as one or both ends of respective colonies are torn considerably. In the first colony the proximal part about 20 cm.

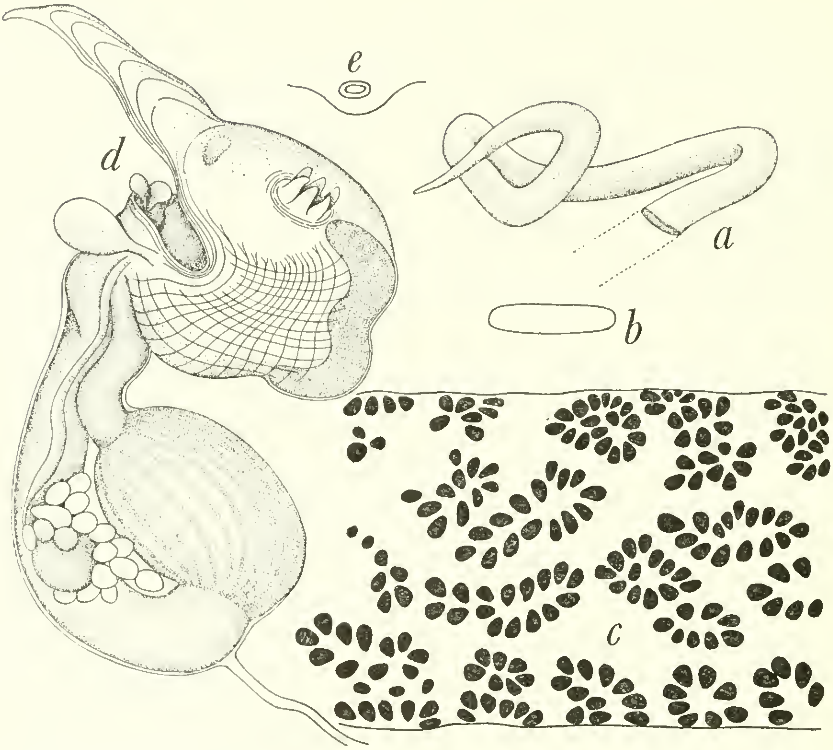

FIGURE 47.—*Distaplia cylindrica* (Lesson) f. *typica:* *a*, proximal half of the 134 cm. colony, sta. 106, *b*, outline of transverse section of colony; *c*, systems found in part of same colony; *d*, right side of a zooid from same colony; *e*, ciliated groove.

long tapers into a kind of peduncular portion where zooids are distributed only sparsely or are partly absent.

Colony consists of a bundle of yellowish-white fascicular vessels running along axis of colony and embedded in a somewhat loose, soft, translucent, and milky whitish test matrix. These vessels issue from the right posterior part of abdomens of respective zooids. Zooids arranged in systems as shown in figure 47*c*, usually 8 to 17 in each system, although zooids may reach 22–33 in larger elongated systems. Zooids yellowish white in preservative, and attain 3 mm. in length in contracted state. Abdomen about twice as long as contracted thorax.

Branchial aperture 6-lobed, atrial aperture a huge opening with a large languet. About 15 longitudinal muscles on each side of thorax, several dorsal ones of these fairly fine; approximately one dozen strong transverse muscles running beneath the longitudinal ones. Stigmata in each of four rows about 15, parastigmatic vessels well defined. Tentacles about 12, larger and smaller ones alternate rather regularly. Ciliated groove (fig. 47*e*) a small oval opening. Dorsal languets large and displaced to the left side from dorsomedian line.

Stomach situated near middle of abdomen, pyloric end passes to intestinal region without forming any marked constriction; hind stomach and middle intestine quite obscure. About 20 longitudinal plications seen clearly on surface of stomach. Contents of the stomach and intestine seem to consist of pelagic diatoms. Anus bilobed. Gonad occupies right side of intestinal loop. Testicular follicles up to 30–40, ovary situated near center of gonad and consists of about 3 ova. A number of embryos in various stages of development found among fascicular vessels of colony.

Order Phlebobranchia: Family Diazonidae

59. *Syndiazona grandis* Oka

Aphanibranchion japonicum Oka, 1906a, p. 253, pl. 13.
"*Aphanibranchion japonicum*" Tokioka, 1953a, p. 215, pl. 27, figs. 4–7.

MATERIAL EXAMINED

JAPAN: Honshu Island; off Omai Zaki Light, N. 17° E., 14.5 mi.; *Albatross* sta. 3730. Three colonies (USNM 11776).

DESCRIPTION.—Three colonies were examined in the "Aphanibranchion" state, 75 mm., 55 mm., and 40 mm. high and pale grayish brown. The thorax was missing in all examined zooids.

REMARKS.—*Polycitor giganteus* Sluiter, 1919, seems to represent an intermediate state between *Syndiazona* and *Diazona*, but more intensive examinations of this species are desirable before the genera *Syndiazona* and *Diazona* can be united.

Family Cionidae

60. *Ciallusia longa* Van Name

FIGURE 48

Ciallusia longa Van Name, 1918, p. 124, figs. 79–81.—Millar, 1963a, p. 623, figs. 1–3.

MATERIAL EXAMINED

PHILIPPINE ISLANDS: Between Samar and Leyte; vicinity of Surigao Strait; *Albatross* sta. 5483. Nine specimens (USNM 11738).

DESCRIPTION.—Nine specimens from the Philippine waters were examined. Animal consists of a cylindrical body proper and an elongated peduncle, the posterior end of which attaches the animal to the substratum. Trunk 45 mm.–70 mm. in length, peduncle 28 mm.–75 mm. long. Latter may be only half as long as former when short, but it may attain nearly 1½ times the length of trunk. Branchial aperture opens at anteroventral corner of trunk and faces ventral side; atrial aperture located near dorsoanterior corner of trunk at level slightly posterior to branchial aperture and opens forwards. Test gelatinous and transparent, but seems to be slightly harder than in *Ciona intestinalis;* surface quite smooth and free from any foreign matter. Mantle thin, delicate, and transparent. Dorsal lip of branchial aperture markedly developed, overhanging on anterior side of aperture, and with edge divided into several finger-shaped prominences, ventral half of aperture margin quite plain. Atrial aperture distinctly 6-lobed. Siphonal musculature consists of only circular sphincters. A pair of rows of short transverse muscles are on both dorsal and ventral sides. Transverse muscles 30–35, on right side of endostyle, confined to anterior half of body anterior to level of distal one-third of intestine; about 60 transverse muscles on left side of endostyle along its whole length. Approximately 40 transverse muscles on right side of the dorsomedian line along whole body length and about 30 on left side of the dorsomedian line in the anterior half of the body and along left side of the intestine. Also several transverse muscles found on dorsomedian line just behind atrial siphon, being united in a zigzag-fashion. Basal part of the branchial siphon surrounded with about 20 short longitudinal muscles. A thin vascular vessel issues from posterior end of body and proceeds deeply into peduncle.

Posterior end of branchial sac reaches nearly to rear of body. From 54–57 inner longitudinal vessels on each side near the middle of sac, transverse vessels arranged in the order—thick P thin P thick—(where P represents the parastigmatic vessel); one to three stigmata in a mesh. Inner longitudinal vessels supported at tip of many supporting processes, but devoid of papillae. Tentacles about 40, larger and smaller ones differentiated, may reach 80 when minute ones are counted. Generally tentacles on dorsal side larger than on ventral side. Ciliated groove C-shaped; dorsal languets tentacle-shaped, about 100 in examined specimens. Esophagus very short, opens at dorsoposterior corner of branchial sac. Entire alimentary canal ascending; stomach small, one-sixth to one-seventh of the whole canal, roughly elliptical in outline, and situated obliquely; about 15 distinct longitudinal plications discernible on surface. Anus situated slightly anterior to middle of body, its margin cut into a dozen lobules. A distinct oviduct runs along dorsal side of intestine from level of pyloric end of stomach to that of anus; ovarian tissue develops along posterior half of this duct. Testicular follicles minute, spread along dorsal side of stomach and proximal half of intestine. A vessel with a conspicuous swelling near its anterior end bridges the middle of dorsal side of stomach and intestine at the level of proximal one-third.

REMARKS.—The present descriptions differ from Van Name's original (1918) in the number of transverse body muscles (20–30 in Van Name's descriptions) and the appearances of the branchial aperture and the stomach (no description is given by Van Name of the longitudinal plications of the stomach). However, reexamination of Van Name's type specimen revealed that such differences were due to somewhat imperfect condition of the type specimen, and it was confirmed that the present specimens were identical with Van Name's

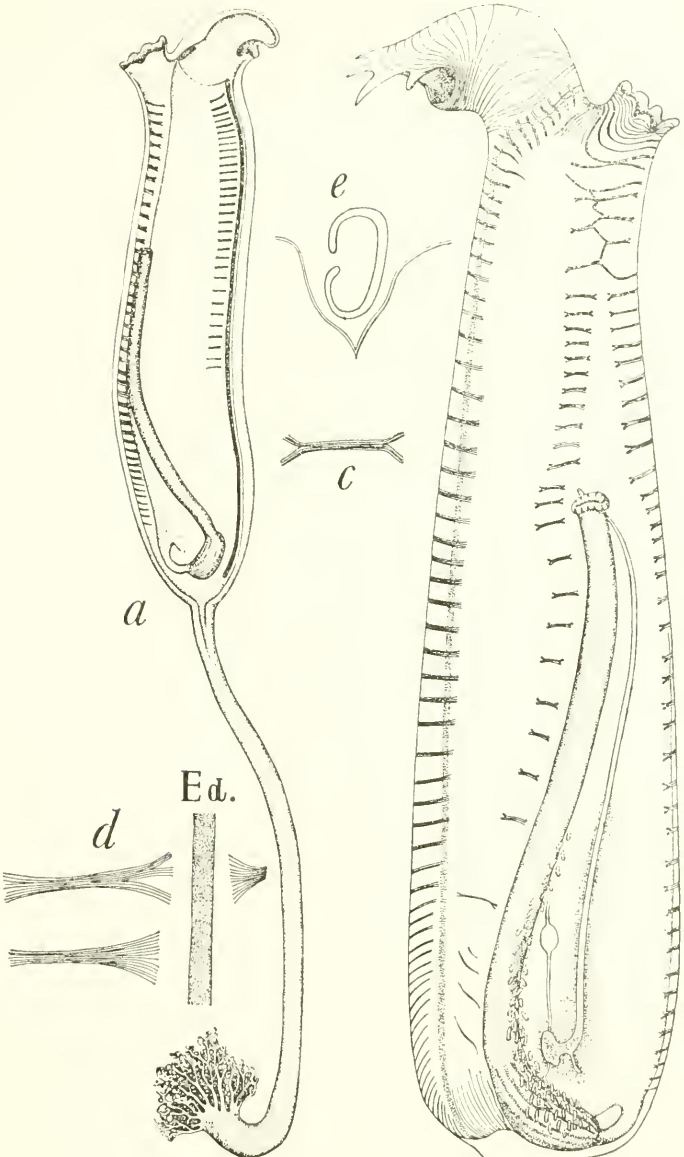

Figure 48.—*Ciallusia longa* Van Name: *a*, right side of the 55 mm. individual; *b*, left side of the mantle body; *c*, dorsal transverse muscle; *d*, part of endostyle and fragments of ventral transverse muscles; *e*, ciliated groove.

type specimen. Evidently, the number of transverse body muscles is somewhat variable and the longitudinal plications on the stomach may be rather faint in some specimens.

The present species superficially resembles *Pterygascidia mirabilis* Sluiter, 1904, from the Siboga area. At first, I considered the present specimens as the second species of the genus *Pterygascidia*, although there are the following differences: *Pterygascidia* has (1) a pair of remarkable fin-shaped semicircular prominences on the dorsal side just behind the atrial aperture; (2) an oblique row of short muscular pieces on each side of the anterior half of the body; (3) no real stigmata on the branchial sac; (4) esophagus considerably long, proceeds forward at first, turns backward to the posterior end of the body and then runs anteriorly again to the stomach; and (5) dorsal lamina a plainly edged membrane. The third difference is somewhat important, but Sluiter's figure (pl. 7, fig. 2) seems to show an intermediate state between the stigmatal structure and the strictly nonstigmatal one. For this reason this point cannot be accepted as an essential generic characteristic differentiating the present specimens from *Pterygascidia.* The differences 1, 2, and 4 can be of specific importance, but they cannot be accepted as generic characteristics. However, the last difference is considered as a very important generic characteristic, and hence I want to retain Van Name's genus *Ciallusia* for the present specimens.

Family Perophoridae

61. *Perophora formosana* (Oka)

Ecteinascidia formosana Oka, 1931a, p. 173, 3 figs.
Perophora bermudensis Berrill, 1932, p. 80, fig. 3A.
Perophora orientalis Ärnbäck-Christie-Linde, 1935, p. 6, 1 fig.
Perophora formosana Tokioka, 1953a, p. 218, fig. 9; pl. 31, figs. 4–5.

MATERIAL EXAMINED

PALAU ISLAND: Iwayama Bay, east side of Oyster Pass; GVF sta. 220. One zooid (USNM 11441).

WAKE ISLAND: C. H. Edmondson, sta. 613. One large colony (USNM 11756).

DESCRIPTION.—A single individual from the Palau Islands and a large colony consisting of a number of zooids from Wake Island were examined. The specimen from the Palau Islands is a zooid 2 mm. long, its test and mantle are transparent and a small amount of purplish-brown pigments are contained between the stigmata which are arranged in five rows, but a few of them extend to both the first and the second rows. In the specimens from Wake Island, the mantle musculature passes through both anterior and posterior sides of the atrial aperture. Each stigmatal row contains 20–25 stigmata.

62. *Perophora* species

MATERIAL EXAMINED

Philippine Islands: Pangapuyan Island, Bavara at the other side of Sitio, 1 fathom; W. R. Taylor, January 1941. Sand, mud, and stone with eelgrass. Two specimens (USNM 11677).

Remarks.—The two individuals are in such poor condition that specific identification is quite impossible.

63. *Ecteinascidia imperfecta* Tokioka

Figure 49

Ecteinascidia imperfecta Tokioka, 1950, p. 129, fig. 9, *3–4*.

MATERIAL EXAMINED

Palau Islands: Iwayama Bay, east side of Oyster Pass; GVF sta. 220. One colony (USNM 11440).

Description.—A single colony was examined, consisting of a stolon creeping on the surface of a shell of *Isognomon* sp., and four zooids.

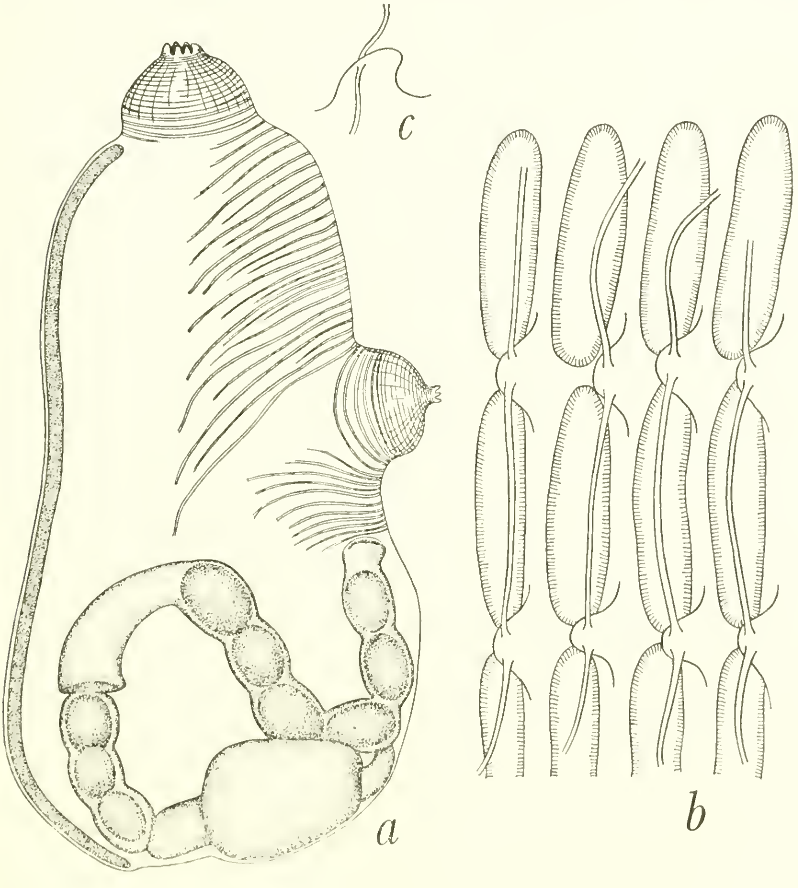

Figure 49.—*Ecteinascidia imperfecta* Tokioka: *a*, left side of mantle body; *b*, part of inner surface of branchial sac; *c*, one of the prominences supporting inner longitudinal vessels at crossing points between longitudinal and transverse vessels.

One zooid very small, the others about 3.5 mm. in length when measured on mantle body. Animals laid with ventral side down. Branchial aperture terminal and 6-lobed, atrial aperture situated near middle of body and also 6-lobed (?). Both siphons short. Test very thin, quite transparent; mantle and wall of stolon pigmented heavily in purplish brown. A number of transverse muscles on right side of body, on left side only about 25 transverse oblique muscles are in dorsal half of body anterior to atrial siphon, about 10 just posterior to atrial siphon. Stigmatal rows 17, about 8 stigmatal rows in area posterior to anterior margin of intestinal loop. Inner longitudinal vessels approximately 20 on each side; generally a single stigma in each interval between longitudinal vessels. Very small papillae (fig. 49*c*) at crossing points between longitudinal and transverse vessels. Tentacles about 30, larger and smaller ones discernible. Ciliated groove a longitudinal slit. Dorsal languets very prominent, nearly one dozen. Stomach oval in outline, both hind stomach and middle intestine distinctly defined. Second intestinal loop very deep, axis passes through esophageal region. Anterior margin of intestinal loop located at level slightly posterior to base of atrial siphon. No gonads found.

Family Ascidiidae

64. *Ascidia sydneiensis samea* (Oka)

FIGURE 50

Ascidia samea Oka, 1935, p. 461, figs. 31–32.

Ascidia sydneiensis samea Tokioka, 1953a, p. 226, pl. 34, figs. 6–10; pl. 35, figs. 1–10; pl. 36, figs. 1–10.

MATERIAL EXAMINED

PHILIPPINE ISLANDS: Off Jolo Island; *Albatross* sta. 5558. One specimen (USNM 11744).

DESCRIPTION.—A single specimen from the Philippine waters was examined. It is 65 mm. long by 31 mm. wide, fairly flattened laterally and attached to the substratum by the whole left side.

Branchial siphon terminal, posterior base of atrial siphon situated approximately at middle of body; both siphons moderate in length. Test rather hard, gelatinous, pale grayish yellow. Surface smooth, carries no foreign matter. On each side of the base of branchial siphon are 10–20 short longitudinal muscles, but most parts of right side of body are provided with only transverse muscles; all are short, confined to area along periphery of body, although some vessels connect edges of transverse muscles across central muscleless area. Branchial aperture 7-lobed, atrial aperture 6-lobed, all lobes pectinated.

On each side of branchial sac 50–60 inner longitudinal vessels; transverse vessels about 150, arranged in order—thick thin thin thin medium thin thin thin thick—; papillae at crossing points between longi-

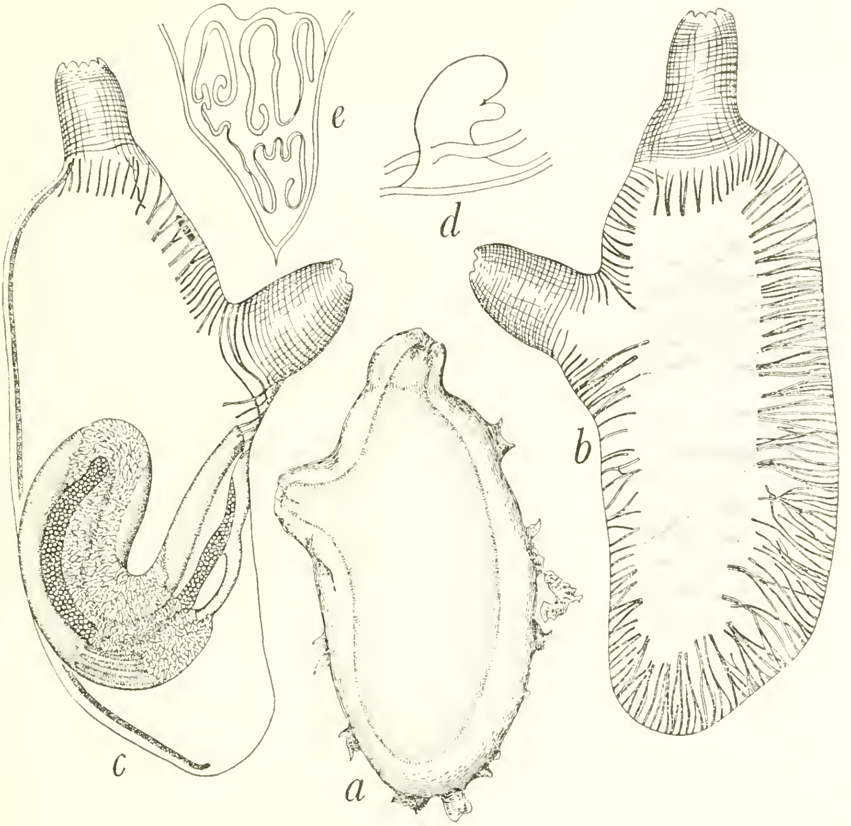

FIGURE 50.—*Ascidia sydneiensis samea* (Oka): *a*, 65 mm. specimen; *b*, right side of mantle body; *c*, left side of mantle body; *d*, one of the supporting prominences of inner longitudinal vessels; *e*, ciliated groove.

tudinal and transverse vessels very conspicuous, intermediate papillae absent. Roughly one plication in each interval between longitudinal vessels, 8 to 9 elongated stigmata seen in each plication. Tentacles about 40, the arrangement—large small medium small large—may be seen at some places. Ciliated groove consists of two elongated grooves curving complicatedly. Dorsal lamina ribbed, although edges of ribs scarcely project from laminal margin. Two pontid shrimps found in branchial sac. Anterior margin of intestinal loop situated at level of middle of base of atrial siphon. Esophagus moderate in length, opens roughly at middle of distance between atrial siphon and posterior end of body. Stomach rather elongated with several longitudinal plications seen faintly through wall. Second intestinal loop very deep, its axis passes through pyloric half of stomach. Margin of anal lobes plain. Male and female gonads show configuration generally seen in usual species of *Ascidia*, testicular follicles spread over proximal branch of second intestinal loop and cardiac half of stomach.

REMARKS.—The present specimen conforms well to *Ascidia sydneiensis samea* from Japanese waters in details of the structure of the branchial sac, although the existence of vessels connecting some of the widely interrupted transverse muscles on the right side seems to be unique for the Philippine specimen. The structure and arrangement of the alimentary organs in the present specimen closely resemble the specimens from the Philippine waters of *Ascidia depressiuscula* Heller which were described by Van Name. The arrangement of the mantle musculature and the appearance of the ciliated groove, however, differ distinctly between the present specimen and Van Name's specimens of *A. depressiuscula.*

65. *Ascidia gemmata* Sluiter

FIGURE 51

Ascidia gemmata Sluiter, 1895, p. 177, pl. 9, figs. 7–9.—Sluiter, 1904, p. 29.–Hartmeyer, 1919, p. 95, fig. 19; pl. 2, fig. 49.—Tokioka, 1950, p. 131, fig. 11; pl. 9, fig. 2.—Tokioka, 1952, p. 103, fig. 9.

MATERIAL EXAMINED

MARIANAS ISLANDS: Saipan, Tanapag Harbor; P. E. Cloud, sta. D–7. One specimen (USNM 11502).

CAROLINE ISLANDS: Kapingamarangi Atoll; lagoon reef Hare, in *Pocillopora;* Cadet Hand, Sta. 333, July 20, 1954. One specimen (USNM 11768).

WAKE ISLAND: C. H. Edmondson, sta. 606. Three specimens (USNM 11754).

DESCRIPTION.—Five specimens are in the material: three 10–29 mm. individuals from Wake Island, a 30 mm. long individual from Hare, Kapingamarangi, and a small 14 mm. long specimen from Saipan Island. The animals attach to the substratum by the left side.

Branchial aperture terminal; atrial aperture usually situated approximately at level of posterior one-third of body (fig. 51*a*). However, on specimen from Saipan which is strongly contracted in anterior half of body (figs. 51*b*, c), 9-lobed atrial aperture opens near middle of body. Test gelatinous, translucent or transparent, faintly milky white; consistency varies from soft to hard; comparatively thick, smooth on surface. Mantle of moderate thickness, musculature on right side where transverse muscles are rather dominant. Many yellowish corpuscles in anterior half of mantle body in some specimens, which may indicate that this portion might be reddish in living animals.

In 14 mm. long individual about 80 transverse vessels, all nearly of same thickness, plications hardly observable. About 40 inner longitudinal vessels on right anterior half of sac. Usually 2 (rarely 3) stigmata in a mesh, intermediate papillae absent. Dorsal lamina supported by many ribs, the tips protrude from free margin of lamina. Specimen 30 mm. long has 42 inner longitudinal vessels, its ciliated groove simple, U-shaped (fig. 51*g*). Ciliated groove in other specimens divided into 2 to 6 sections (figs. 51 *e*, *f*). Anterior margin of intestinal loop reaches middle of distance between bases of both

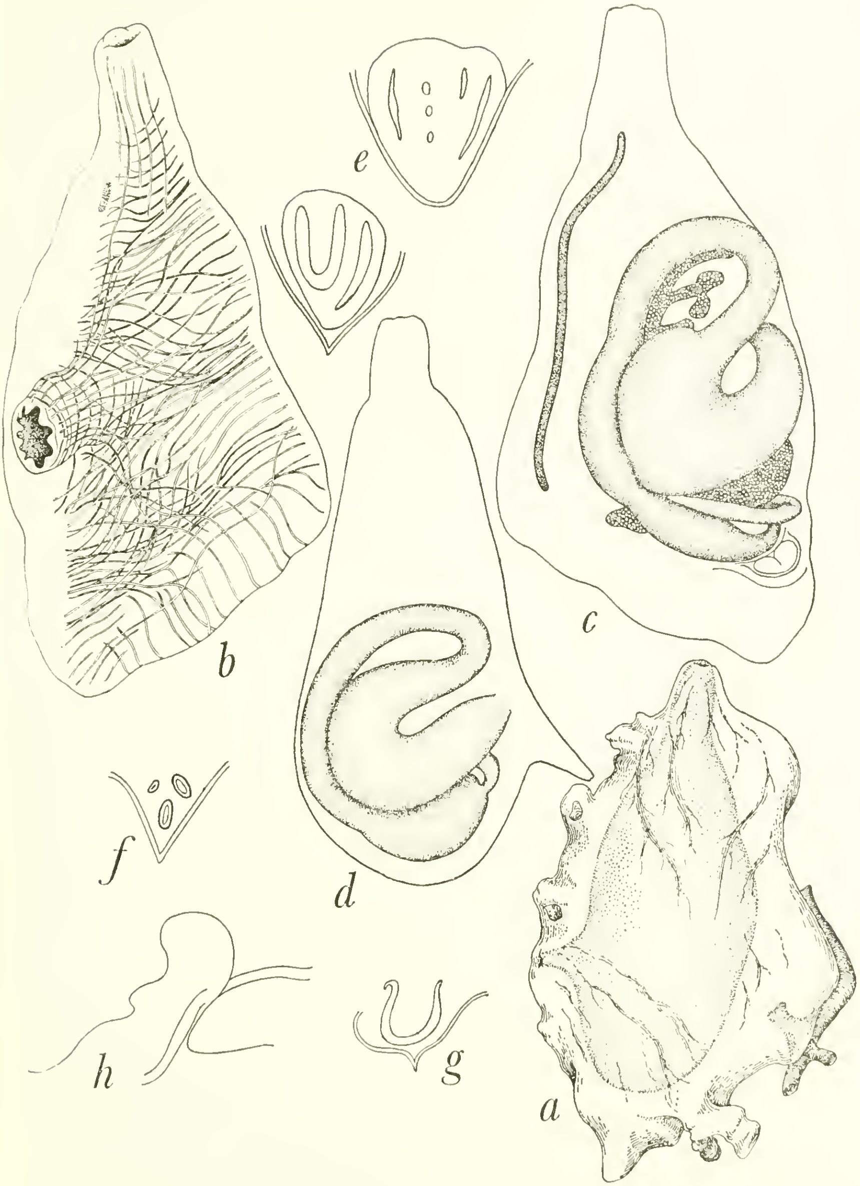

Figure 51.—*Ascidia gemmata* Sluiter: *a*, specimen from Kapingamarangi. *b–d*, Mantle body: *b*, right side, Saipan specimen; *c*, left side of same; *d*, left side, a Wake specimen. *e–g*, Ciliated grooves: *e*, Wake specimens; *f*, Saipan specimen; *g*, Kapingamarangi specimen. *h*, A papilla at crossing point between longitudinal and transverse vessels, the Saipan specimen.

siphons. Second intestinal loop deep, its axis passes through pyloric end of stomach or proximal portion of intestine; turning part of loop considerably swollen.

66. *Ascidia minuta* Tokioka

FIGURE 52

Ascidia minuta Tokioka, 1950, p. 129, fig. 10.

MATERIAL EXAMINED

PALAU ISLANDS: Barrier reef 8 mi. NW. of Koror Island; GVF sta. 25. Two small specimens (USNM 11384).—Iwayama Bay, Geruherugairu Pass; GVF sta. 85. One specimen imperfectly preserved (USNM 11451).

DESCRIPTION.—Of the three specimens examined from the Palau Islands, two are probably juveniles and less than 3 mm. in length, the other is 8 mm. in length and torn in the posterior part of the body.

Branchial aperture terminal, 6-lobed, each lobe more or less subdivided into two lobules; atrial aperture situated near middle of right side of body and 10-lobed in largest specimen. Test thin and translucent or transparent, surface usually holds fine sand or other foreign

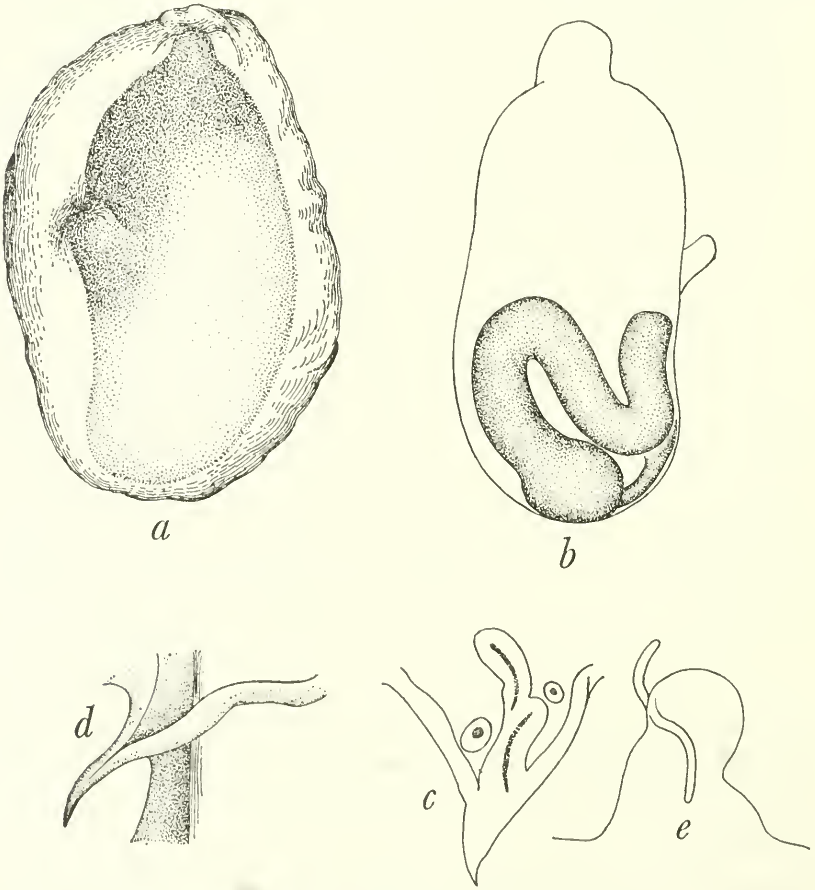

FIGURE 52.—*Ascidia minuta* Tokioka: *a*, 3 mm. specimen; *b*, left side of mantle body of same; *c*, ciliated groove of 8 mm. specimen; *d*, dorsal languet of same; *e*, a supporting process of inner longitudinal vessels.

matter. Mantle yellowish brown to brownish, especially pigmented dark brownish in anterior one-third of body, including both siphons. Right side of mantle wholly reticulated with fine muscular fibers, the transverse ones remarkably dominant. Anterior margin of intestinal loop does not reach beyond level of base of atrial siphon. Axis of second intestinal loop passes through the esophageal region. Both hind stomach and middle intestine obscure. Individual 8 mm. long has 21 partly imperfect inner longitudinal vessels on each side; 19 dorsal languets counted in this rather imperfectly preserved specimen. Languets are distal portions of prominent ribs supporting low dorsal lamina. About two stigmata in each mesh. Supporting processes of inner longitudinal vessels roundish distally and hold longitudinal vessels on their ventral side near distal end; intermediate papillae absent. Tentacles about 20, larger and smaller ones differentiated. Ciliated groove an elongated slit interrupted near middle with two minute openings; dorsal tubercle apart from dorsal ganglion for length of ganglion.

67. *Ascidia aperta* Sluiter

Figure 53

Ascidia aperta Sluiter, 1904, p. 38, pl. 2, fig. 4; pl. 6, figs. 1–5.—Van Name, 1918, p. 119, fig. 75–76.—Tokioka, 1954a, p. 257, pl. 32, figs. 2–8; pl. 33, figs. 1–4.

MATERIAL EXAMINED

Marshall Islands: Rongelap Atoll; Naen Island, below low tide, in lagoon; M. W. Johnson, coll., July 12, 1946. Seven specimens (USNM 11537).

Description.—There are seven specimens from Rongelap Atoll, 23–40 mm. in length and attached to the substratum by the whole left side.

Branchial aperture terminal and 9-lobed, atrial aperture opens slightly posterior to middle of body and 6-lobed. Both siphons short but stout; lobation of each aperture rather indistinct. Test translucent or transparent, soft, gelatinous, and pale yellowish. Surface nearly smooth, carries no foreign matter. The most striking feature of these specimens is that the mantle is almost completely devoid of body musculature, except for poorly developed siphonal musculatures. Musculature of branchial siphon consists of about 10 fine sphincters confined to distal half of siphon (indicating anterior distal portion in front of peripharyngeal band); atrial siphon consists of 2 or 3 marginal sphincters and 1 or 2 other fine circular muscles located slightly apart from marginal ones, also 6 groups of fine and short retractors at each interval between lobes.

Branchial sac of a 25 mm. long individual has 71 transverse vessels and 50 inner longitudinal vessels on each side. Plications absent; 4 stigmata in each mesh; intermediate papillae present (fig. 53*c*). Tentacles about 20, larger and smaller ones differentiated; larger

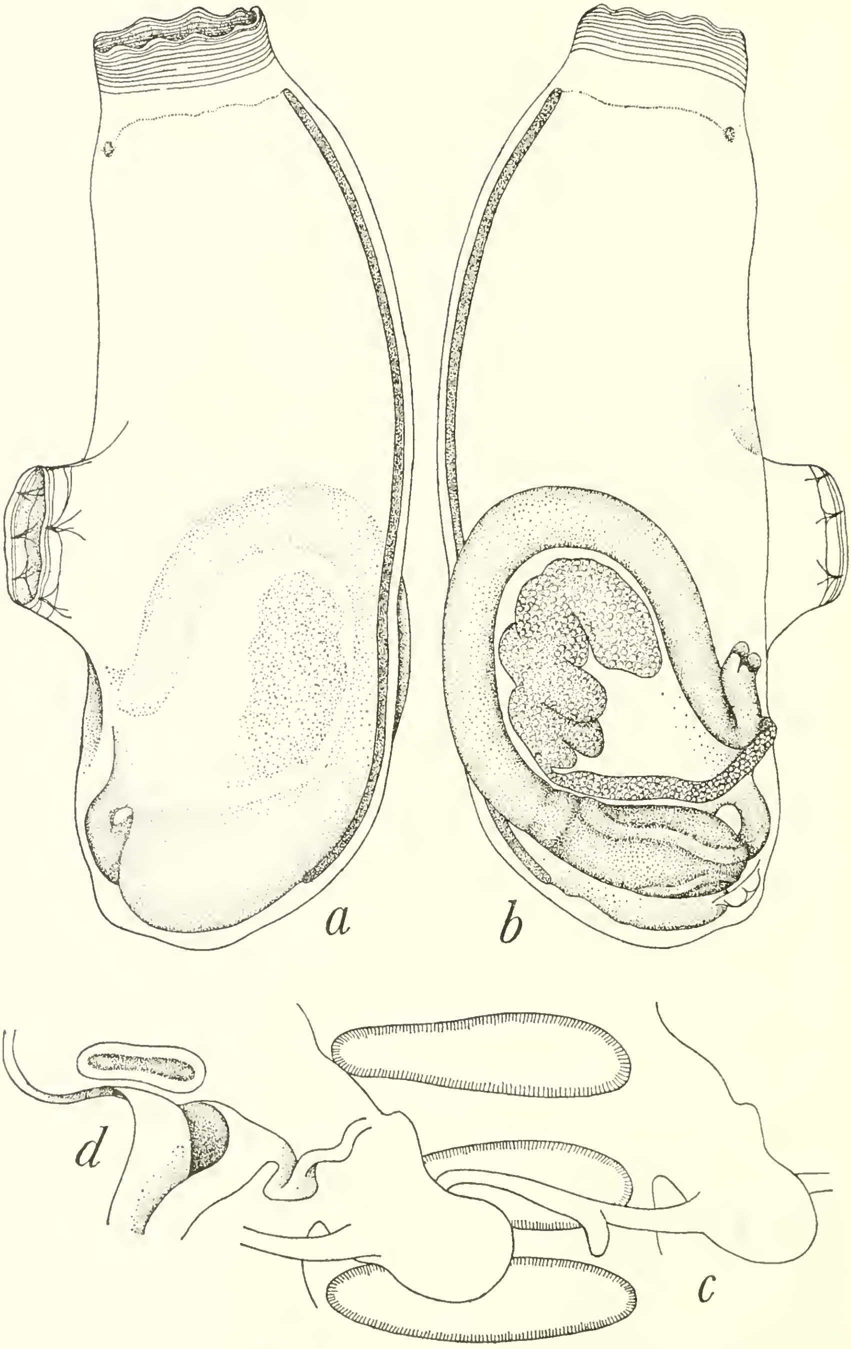

Figure 53.—*Ascidia aperta* Sluiter: *a*, right side of mantle body; *b*, left side of same; *c*, two supporting papillae of inner longitudinal vessels; *d*, ciliated groove.

ones arranged at level just behind posteriormost branchial sphincter, smaller ones situated more anteriorly. Ciliated groove a short transverse groove (fig. 53*d*) located in front of dorsal ganglion, separated by the length of one to two ganglions. Dorsal lamina supported by ribs, its margin serrated. Two laminae along dorsomedian line just behind ciliated groove, roughly for distance of length of branchial siphon. Anterior margin of intestinal loop reaches level of anterior base of atrial siphon. First loop very spacious; second loop extremely shallow, its axis passes through esophagus, which opens to branchial sac slightly anterior to dorsoposterior corner of body. Two ridges on left side of stomach. Anal margin may be thickened, undulating, or divided into a few lobes in some specimens.

Remarks.—The present specimens are characterized by their poor musculature on the right side of the mantle body. Numbers of transverse and inner longitudinal vessels seem to be more numerous in the present specimens than in specimens, from the Tokara Islands, described by Tokioka in 1954. In spite of the existence of abovementioned specialty and differences between the Rongelap specimens and previously described ones, the former may be identified safely as *Ascidia aperta*, because the most important characteristic of the species, the structure of the alimentary system, conforms exactly to that of the present specimens. Vessels in the mantle are found full of yellowish corpuscles, which seems to indicate that these animals might have been reddish orange when they were alive.

68. *Ascidia papillosa*, new species

Figure 54

Holotype.—USNM 11732: Japan; Honshu, off Noma Saki S. 86° E., 5.7 mi., 19–20 fath., mud, sand, pebbles, and shells; *Albatross* sta. 3724, May 15, 1900.

Description.—A flattened specimen 42 mm. long by 17 mm. wide from off Honshu Island, Japan, is described. Animal attached to substratum by entire left side, yellowish brown, surface covered sparsely with mud. Branchial aperture terminal and 8-lobed; atrial aperture 6-lobed, situated near middle of body, its posterior margin just at the middle; both siphons short. Many small (about 1.5 mm. long) hollow, finger-shaped protuberances over free surface of test, set especially densely around apertures. Right side of mantle body wholly reticulated with musculature, which consists chiefly of longitudinal and transverse muscles in anterior and posterior parts of body, very complicated musculature in middle of body.

Inner longitudinal vessels 31 on each side, transverse vessels 125. About 7 stigmata on each plication. Nearly 100 tentacles, smaller, medium, and larger ones differentiated. About 50 smaller tentacles arranged in intervals between larger and medium ones. Ciliated groove

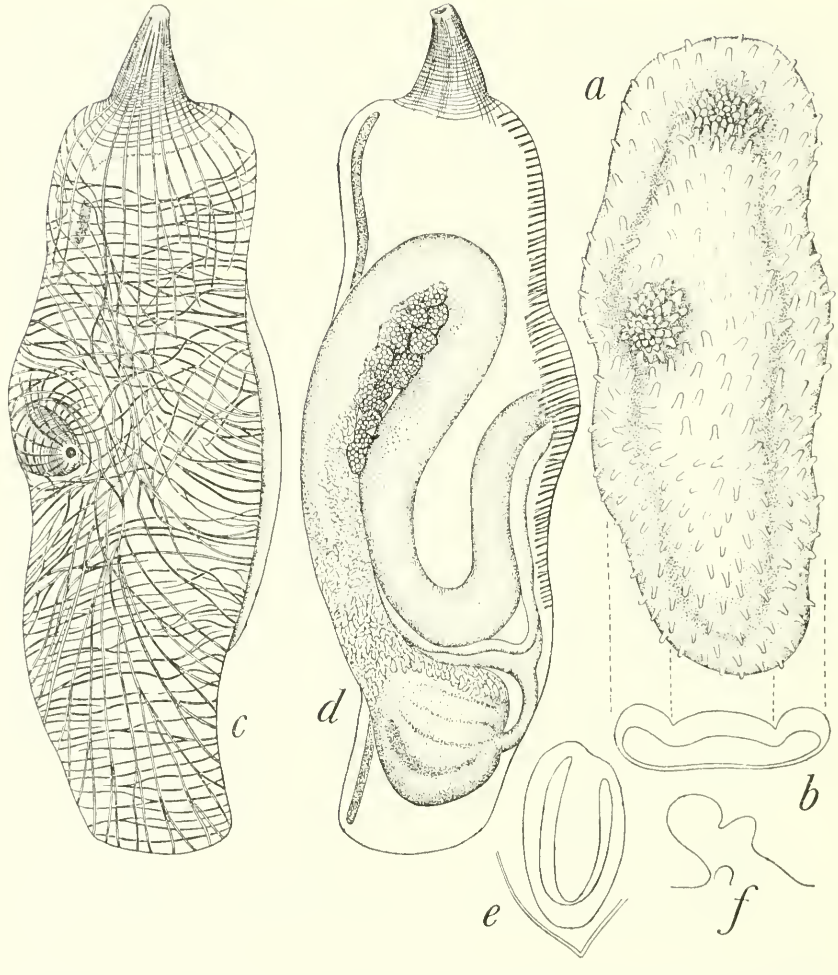

FIGURE 54.—*Ascidia papillosa,* new species: *a,* right side of holotype; *b,* optical section of middle part of test; *c,* right side of mantle body; *d,* left side of same; *e,* ciliated groove; *f,* a supporting process of inner longitudinal vessels.

simply U-shaped, situated in front of dorsal ganglion, separated from ganglion by distance of 1.5 times the length of the ganglion. Dorsal lamina ribbed, tips of ribs project from laminal margin. Anterior margin of intestinal loop reaches middle of range between both siphons. Second intestinal loop very deep, axis passes approximately through middle of roundish stomach. Anal margin plain. Ovary situated at inner part of first intestinal loop; testicular follicles spread over proximal half of ventral branch of first intestinal loop and anterior margin of stomach.

REMARKS.—The structure of the alimentary system in the present specimen resembles that of *Ascidia longistriata* Hartmeyer, 1906, although the anterior margin of the intestinal loop reaches more anteriorly than in *A. longistriata.* Inner longitudinal vessels are somewhat fewer than in *A. longistriata.* Particularly, the spinose appearance of the test is unique in the present specimen. Probably the specimen should be treated as a distinct species closely related to *A. longistriata.*

69. *Phallusia julinea* Sluiter

FIGURE 55

Phallusia julinea Sluiter, 1919, p. 7, figs. 13–16.—Hartmeyer, 1919, p. 99, fig. 20; pl. 2, figs. 51–53.—Hastings, 1931, p. 81.—Tokioka, 1950, p. 133, fig. 13; pl. 9, fig. 4.—Tokioka, 1952, p. 107, figs. 11–12.

MATERIAL EXAMINED

PALAU ISLANDS: Iwayama Bay, south end of Guazima; GVF sta. 92A. One specimen (USNM 11406).—Iwayama Bay, south end of Island XX; GVF sta. 134. Three specimens (USNM 11416).

DESCRIPTION.—Four specimens were examined from the Palau Islands, respectively, 40, 59, 60, and 62 mm. in length. Ramified vessels full of yellow corpuscles run through the test and can be seen distinctly on every specimen. The appearance of the test surface differs slightly from that of previously described specimens from the same locality (Tokioka, 1950), as the surface is devoid of minute papillae, and is quite smooth in the present specimens. The basal part of the distal branch of the second intestinal loop is swollen remarkably. The 59 mm. long individual was dissected to clarify the structure of the branchial sac. There are 55–65 inner longitudinal vessels on each side, all devoid of intermediate papillae. Tentacles 54, excluding a few minute ones. Secondary dorsal tubercles 48 on left, 30 on right side.

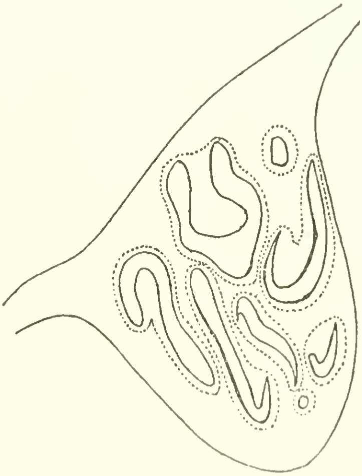

FIGURE 55.—*Phallusia julinea* Sluiter: primary dorsal tubercle of the 59 mm. individual.

Family Rhodosomatidae

70. *Corella japonica* Herdman

FIGURE 56

Corella japonica Herdman, 1880, p. 472.—Herdman, 1882, p. 190, pl. 26.—Traustedt, 1885, p. 9.—Traustedt & Weltner, 1894, p. 10.—Hartmeyer, 1906, p. 25.—Tokioka, 1953a, p. 231, fig. 11; pl. 39, figs, 1–10.

MATERIAL EXAMINED

JAPAN: Honshu; off Ose Zaki, S. 82° W., 3.3 mi.; *Albatross* sta. 3714. One specimen 18 mm. long (USNM 11773).—Honshu; off Noma Saki, N. 18° E., 8.8 mi.; *Albatross* sta. 3725. Specimens 24, up to 44 mm. in length (USNM 11774).

DESCRIPTION.—Most of the specimens from Albatross station 3725 are provided with typical musculature, although the number of muscles varies. The test is rather cartilaginous in these specimens, and the undersides hold sand grains and fine gravel, rooty protuberances are practically absent.

The specimen from station 3714 (USNM 11773) carries coarse sand grains over the body surface, and has many ramified rooty protuberances (figs. 56 *a*, *b*). The musculature consists of a small number of muscles, as in those reported from Sagami Bay (Tokioka, 1953a).

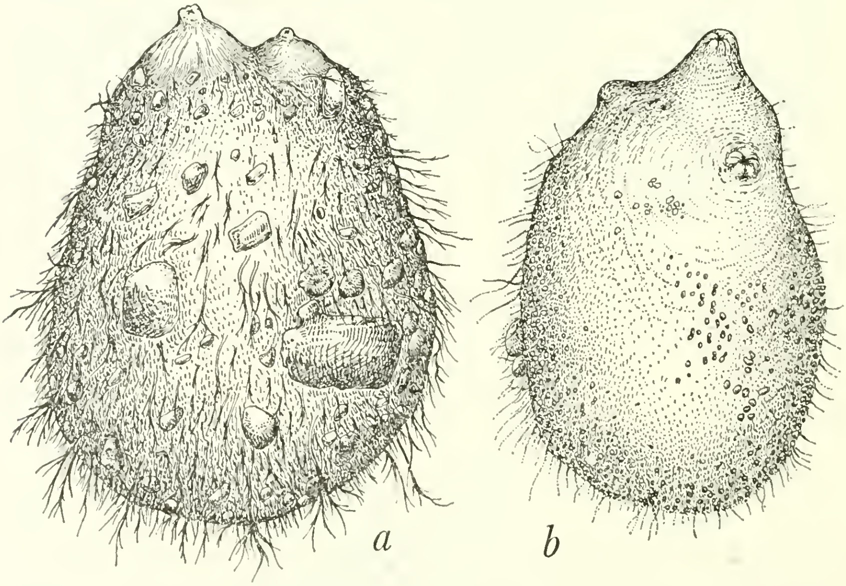

FIGURE 56.—*Corella japonica* Herdman: *a*, the 18 mm. individual from sta. 3714, encrusted with coarse sand grains and with many ramified rooty protuberances; *b*, the other 18 mm. individual from same station, nearly exposed, but partly covered with mud and fine sand.

71. *Corella japonica* var. *asamusi* Oka

Figure 57

Corella japonica var. *asamusi* Oka, 1927a, p. 492, fig. 948.—Oka, 1931b, p. 198.—Oka, 1935, p. 458.

MATERIAL EXAMINED

Japan: Hokkaido Island, Hakodate; E. S. Morse, coll. One specimen (USNM 11695).

Description.—A single specimen was presented to the U.S. National Museum from Tokyo Imperial University, Japan. The specimen is a flat mass measuring 40 mm. by 31 mm. in extent and 7 mm. in thickness. Test rather hard, gelatinous, translucent, faintly milky white, reddish-brown musculature visible through test. Surface mostly covered with mud. Branchial aperture terminal; atrial aperture situated at level of anterior quarter of body length. Muscles much more numerous than in typical specimens described previously (fig. 57). Inner longitudinal vessels 30 on right, 32 on left side. Transverse rows of infundibula about 30. Longitudinal vessels supported in most parts by papillae on transverse vessels and median intermediate papillae.

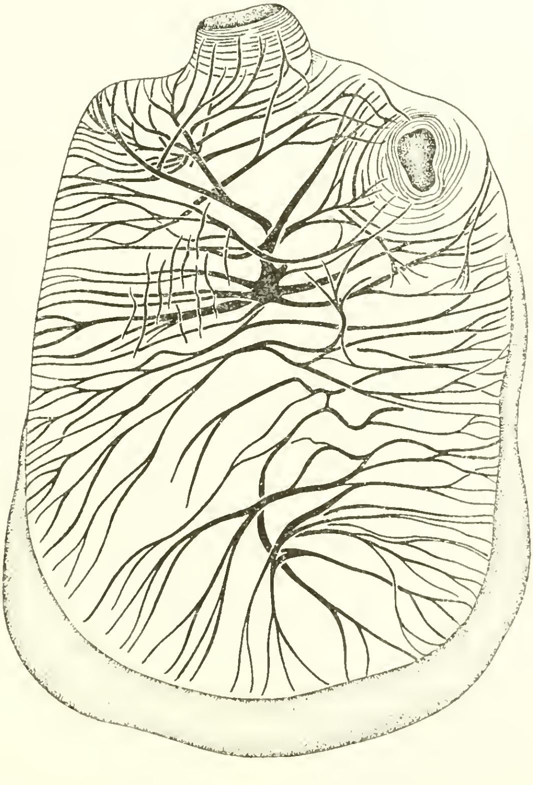

Figure 57.—*Corella japonica* Herdman var. *asamusi* Oka: left side of mantle body, showing strongly developed musculature.

72. *Chelyosoma siboja* Oka

FIGURE 58

Chelyosoma siboja Oka, 1906b, p. 51.—Oka, 1935, p. 460, fig. 30.

MATERIAL EXAMINED

JAPAN: Hokkaido Island, Otaru; E. S. Morse, coll. One specimen (USNM 11690).

DESCRIPTION.—A single specimen was found in the material. It is 50 mm. by 38 mm. in extent, 24 mm. in height, and the siphonal area is 34 mm. by 30 mm. in extent. Animal is attached to substratum somewhat obliquely as shown in lateral view (fig. 58*b*), which is given rather schematically. Test thick, cartilaginous, brownish; surface covered with bryozoans and small algae on some parts. Siphonal area bears 31 plates in all: 23 marginal plates, 2 central plates, 3 intermediate plates on each side. Body surface other than siphonal area is wrinkled or very irregularly grooved.

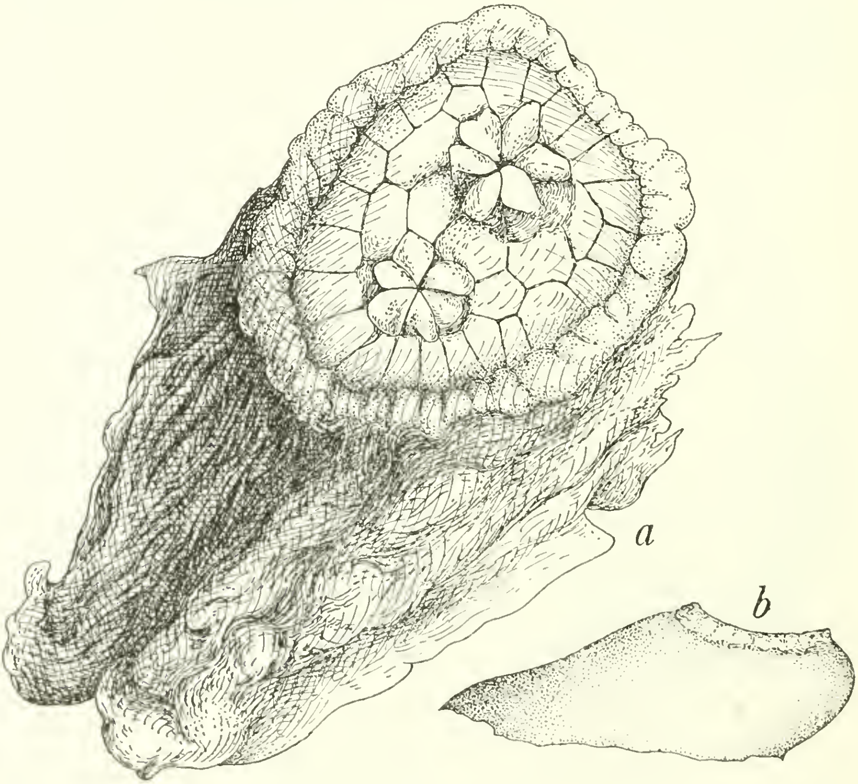

FIGURE 58.—*Chelyosoma siboja* Oka: *a*, apical side of the specimen; *b*, lateral side.

Order Stolidobranchia: Family Botryllidae

73. *Botryllus primigenus* Oka

Botryllus primigenus Oka, 1928, p. 303, figs. A–B.—Van Name, 1945, p. 223, fig. 134.—Tokioka, 1951a, p. 7, fig. 5.—Tokioka, 1953a, p. 236, pl. 42, figs. 1–4.

MATERIAL EXAMINED

CHINA: Vicinity of Amoy; S. F. Light, coll., May 20, 1924. One colony attached to *Telesto* (USNM 11706).

PALAU ISLANDS: Iwayama Bay, mouth of Oyster Pass; GVF sta. 236A. More than 12 small colonies (USNM 11466).

DESCRIPTION.—About a dozen colonies from the Palau Islands and a single extensive encrusting colony from Chinese waters were examined. The former are all very small, crowded on branches of a corallinacean alga, each containing only a few or several zooids. Test transparent, mantle purplish brown. Chinese colony encrusts a horn-shaped alcyonarian colony and measures roughly 40 mm. long by 16 mm. wide at the largest massive portion. Test gelatinous, quite transparent, pale brownish; 9 plications on stomach. In all colonies zooids communicate with exterior through individual branchial and atrial apertures; stigmatal rows always four.

74. *Botryllus tuberatus* Ritter & Forsyth

FIGURE 59

Botryllus tuberatus Ritter & Forsyth, 1917, p. 461, pl. 39, figs, 10 & 12; pl. 40, fig. 22.—Van Name, 1945, p. 225, fig. 135.

Botryllus communis Oka 1927b,, p. 607.—Tokioka, 1951a, p. 8, fig. 6.—Tokioka, 1951b, p. 14, fig. 3.—Tokioka, 1953a, p. 237, fig. 15; pl. 2, figs. 3–4; pl. 42. figs. 5–9.

MATERIAL EXAMINED

CHINA: Probably Amoy; T. Y. Chen, University of Amoy, received October 12, 1932. One colony (USNM 11533).—Vicinity of Amoy; S. F. Light, coll. Two colonies (USNM 11705).

PALAU ISLANDS: Eastern end of Urukthapel Island, outer reef; GVF sta. 28. One colony (USNM 11454).

GILBERT ISLANDS: Onotoa Atoll; P. E. Cloud, sta. GOC–59. Four colonies (USNM 11475).

DESCRIPTION.—A single colony from the Palau Islands, three colonies from Chinese waters, and four small ones less than 3.5 mm.×3 mm. in extent from the Gilbert Islands were examined. The Palau specimen is an encrusting form, 25 mm.×15 mm. in extent and 2 mm. in thickness. The Chinese specimens consist of two massive colonies and one complicatedly shaped colony consisting of 9 club-shaped masses (fig. 59*a*), the largest about 10 mm. in diameter and 20 mm. in length, the smaller ones nearly spherical. Zooids are found only on the upper surface of distal parts of above-mentioned club-shaped masses. The massive colonies are large, about 20 mm. in diameter and up to 42 mm. in length and lobated rather irregularly.

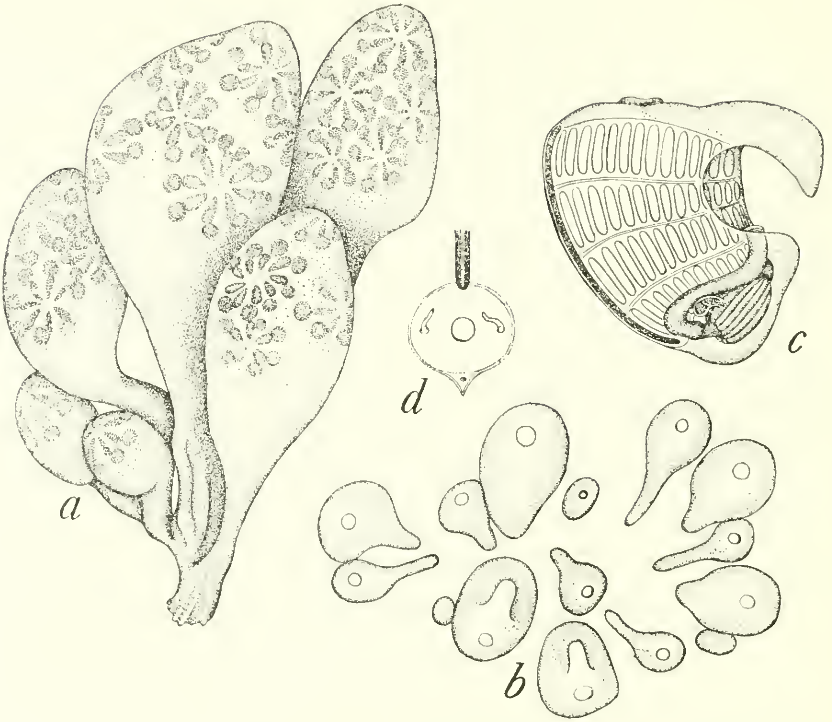

FIGURE 59.—*Botryllus tuberatus* Ritter & Forsyth: *a*, colony from Amoy; *b*, arrangement of contracted zooids in a specimen from China; *c*, 0.5 mm. long young zooid from the Palau Islands colony; *d*, inside of prebranchial area of same zooid, showing two tentacles, enlarged.

Test soft, gelatinous, translucent to transparent, and may be yellowish white or faintly purplish brown. Zooids always pigmented in dark purplish brown and arranged regularly in stellate systems; each system consists of 4–12 zooids, most frequently 7–10. Colony surface usually exposed, although sometimes it carries some mud. Specimens from Palau Islands and Chinese waters seem to be in budding stages, with darkly pigmented old zooids arranged in stellate systems and all contracted strongly; newly formed young zooids colorless or very lightly pigmented, wholly expanded, situated one at ventral side of each old zooid, filling interspace between systems formed by old zooids, but without forming any systems by themselves and sometimes opening to exterior individually. In the colonies from Chinese waters, all zooids have lost communication with the exterior and have buried themselves completely in test. Large old and young small zooids arranged roughly in stellate systems as shown in figure *b;* probably a stage just before reformation of stellate systems by both old and young zooids. Zooids situated obliquely. Stigmatal rows 4, stigmata 11–19 in a row and arranged (D=dorsal, V=ventral): D 4–6

(1) 2–4 (1) 2–4 (1) 3–5 V. Only two tentacles in newly formed young zooids (fig. 59*d*), but at least four in larger old zooids. Anterior margin of intestinal loop reaches middle of fourth stigmatal row or third transverse vessel; anus opens at level of third transverse vessel. Posterior half or two-thirds of stomach located posterior to rear end of branchial sac; 7–10 longitudinal plications on stomach surface, besides typhlosolis.

75. *Botryllus magnicoecus* (Hartmeyer)

FIGURE 60

Botrylloides nigrum var. *magnicoccum* + *Sarcobotrylloides racemosum* Hartmeyer, 1912, p. 271, pl. 41, fig. 11; p. 274, pl. 37, fig. 5; pl. 41, fig. 9.

Botryllus magnicoccus Michaelsen, 1921, p. 6, pl. 1, figs. 1–4.—Michaelsen, 1923, p. 50.—Hartmeyer & Michaelsen, 1928, p. 331.—Hastings, 1931, p. 79, fig. 5.

Polycyclus rufus Oka, 1927b, p. 608.

Botryllus rufus Tokioka, 1953a, p. 240, pl. 2, fig. 5; pl. 43, figs. 4–7.

MATERIAL EXAMINED

CHINA: Probably Amoy; received October 12, 1932, from T. Y. Chen, University of Amoy; sta. 1, no further data, one colony (USNM 11532); sta. 9, no further data, two colonies (USNM 11531).

DESCRIPTION.—Three colonies were examined, the largest is 33 mm. ×15 mm. in extent and 11 mm. in thickness. Colonies irregularly lobate, dark purplish upper layer containing zooids, lower layer translucent, milky white. Test white. Surface free from foreign matter. Very distinct stellate systems, each consisting of 4–11, most frequently 6–9 zooids. Many whitish ampullae are seen between these systems. Zooids rather small, less than 2 mm. in length, situated perpendicularly. Mantle deep purple but may fade to yellowish brown. In branchial sac 9–11 stigmatal rows on right, 10–12 on left side. Second row reaches midline dorsally; last row usually rudimentary. Stigmata arranged (D=dorsal, V=ventral): D 5–6 (1) 2–3 (1) 2–3 (1) 3–5 V. Tentacles 8, larger and smaller ones alternate regularly (fig. 60*b*). Ciliated groove an oval orifice (fig. 60*c*).

Distal branch of first intestinal loop covers posterior two or three stigmatal rows so that anterior margin of loop reaches tenth to seventh transverse vessel. Second intestinal loop very shallow, axis passes through cardiac half or cardiac end of stomach. Anus attached to branchial sac at level of sixth or seventh transverse vessel and opens at level of fifth or sixth transverse vessel; margin plain. Hind stomach faintly constricted from following part of alimentary canal. Stomach quite posterior to branchial sac with 13 longitudinal plications, including typhlosolis, on surface. Pyloric caecum very distinct. Testis situated roughly at level of seventh transverse vessel or eighth stigmatal row near middle on each side, usually right testis located slightly more anterior than left one, approximately for distance of one-half stigma length. Testis consists of three lobules (fig. 60*d*) in

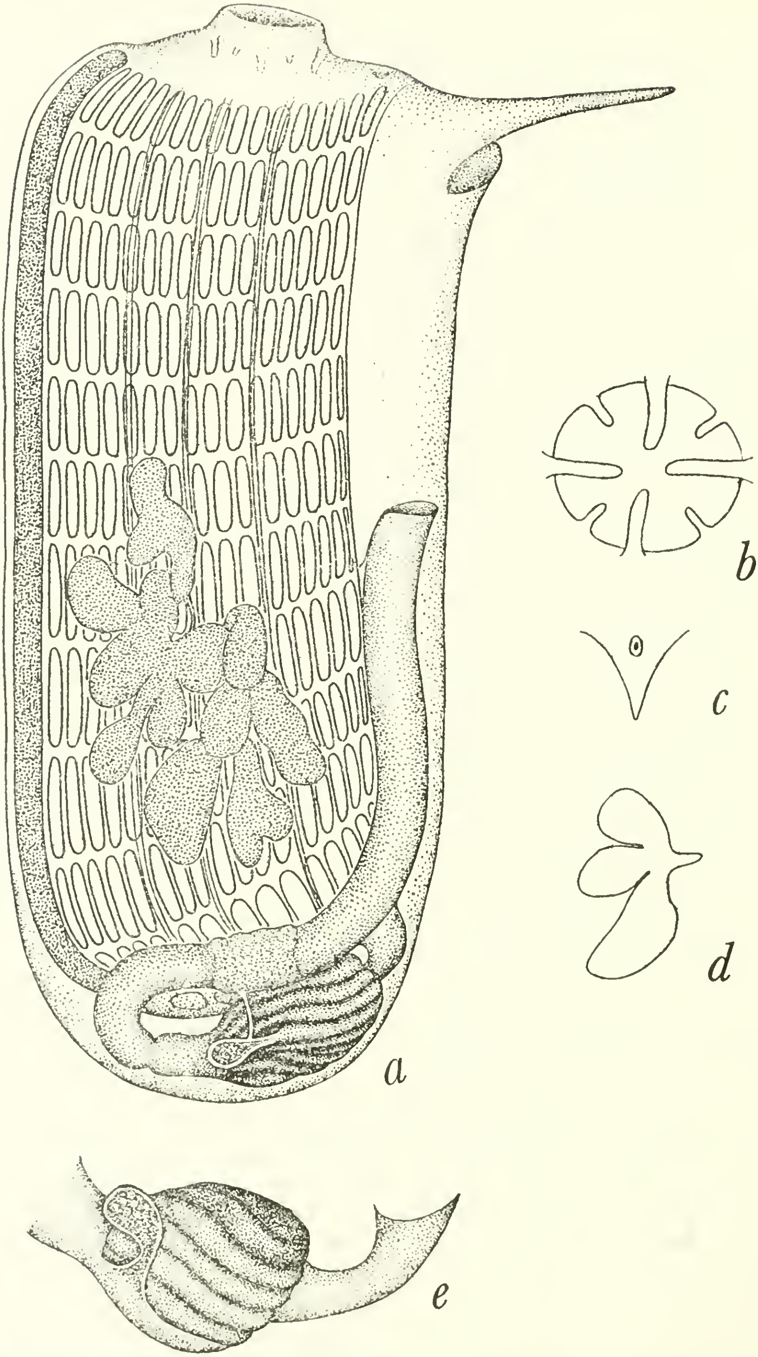

Figure 60.—*Botryllus magnicoecus* (Hartmeyer): *a*, left side of a zooid; *b*, tentacular ring; *c*, ciliated groove; *d*, left testis in early stage; *e*, left side of stomach.

earlier stages, but becomes so voluminous and complex in configuration with growth that at last it spreads over four stigmatal rows (fig. 60*a*).

REMARKS.—Zooids of the present colonies are smaller and with slightly fewer stigmatal rows than those of the colonies described under the name of *Botryllus rufus* (Oka) from Japanese waters, which are about 4 mm. in length and have 14–15 stigmatal rows. However, the general appearance of the colony and that of the zooid, especially the existence of the remarkably long rectum, are common to both the present specimen and *B. rufus.* Therefore I wish to treat *B. rufus* from Japanese waters as a synonym of *B. magnicoecus* (Hartmeyer).

76. *Botryllus compositus*, new species

FIGURE 61

HOLOTYPE.—USNM 11709: Rangoon, Burma. G. E. Gates.

DESCRIPTION.—A single colony from Burmese waters was examined. It is roughly oval in outline, 40 mm. × 24 mm. in extent and 14–15 mm. in thickness, consisting of a number of cormidia which are less than 13 mm. × 7 mm. in extent and most frequently assume the form of a polygonal prism having about 6 mm. diameter (fig. 61*c*), although they may be irregularly lobate (fig. 61*b*).

Surface encrusted with fine sand grains. Zooids arranged regularly in circular systems, each consisting of 7 to 10 zooids. Zooidal layer 2–2.5 mm. in thickness, encrusted with sand only sparsely on surface; test of this part soft, gelatinous, transparent, not impregnated with sand grains. Pinkish zooids seen through test of upper surface, with sand grains missing above zooids. Larger lower part of cormidium below zooidal layer covered densely with sand grains; test there soft, gelatinous, translucent or transparent, and contains fascicular vessels sparsely within, but no sand grains. Zooids about 2 mm. in length, embedded perpendicularly in test. Atrial aperture situated at level of first stigmatal row, with a distinct tongue-shaped languet. Stigmatal rows 8–11 on right and 9–12 on left side. Stigmata arranged (D=dorsal, V=ventral): D 4–5 (1) 3 (1) 2–3 (1) 2–4 V. Dorsal edge of each row reaches median line. Tentacles 8, larger and smaller ones alternate regularly; some zooids have minute tentacles in intervals between large and small tentacles, then number of tentacles increases to 16. Ciliated groove a small oval opening. Intestine covers posterior one or two stigmatal rows. Stomach located behind branchial sac, situated slightly obliquely and with 9–12 longitudinal plications on surface, excluding typhlosolis. Anus attached to branchial sac at level of seventh to fifth transverse vessel and opens at level of sixth to fourth transverse vessel; margin plain. A young individual 0.68 mm. long, not yet having communication with exterior, with 11 stigmatal rows on each side, has a rudi-

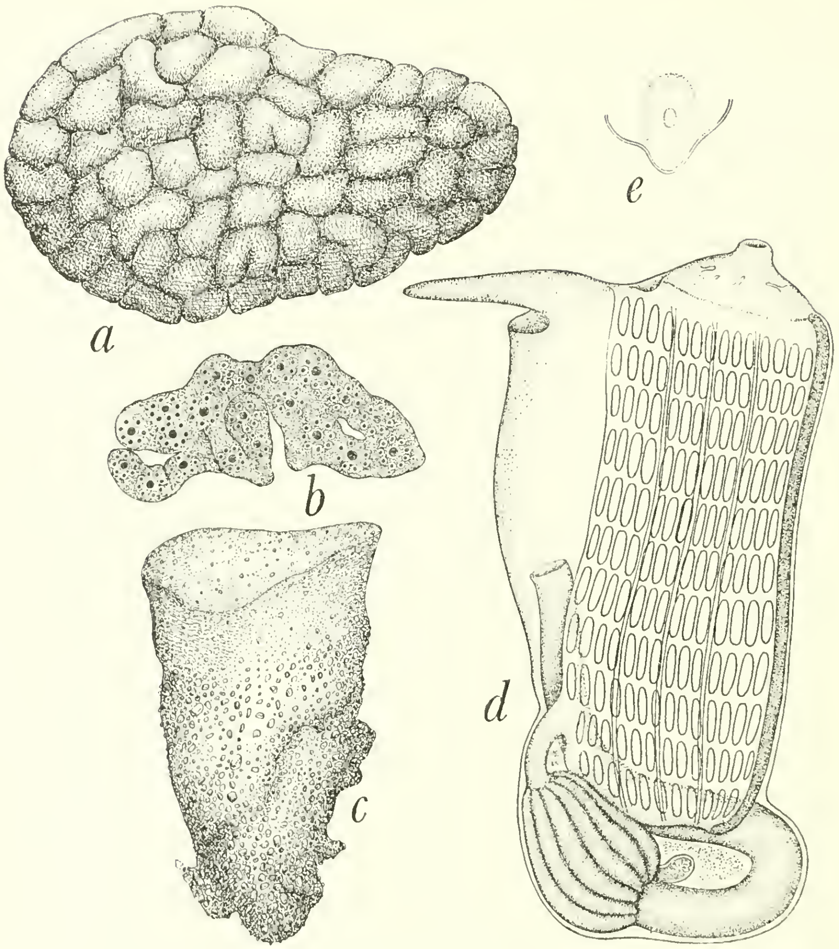

Figure 61.—*Botryllus compositus*, new species: *a*, surface view of colony; *b*, surface of irregularly lobated cormidium; *c*, prism-shaped cormidium; *d*, right side of a comparatively large zooid; *e*, ciliated groove.

mentary testis consisting of several follicles in front of intestinal loop on each side approximately at level of seventh transverse vessel.

Remarks.—The appearance of the colony consisting of a number of cormidia is unique for the present genus, hence it is given the specific name *compositus*.

77. *Botrylloides tyreum* Herdman

Figure 62

Botrylloides purpureum Herdman, 1886, p. 41, pl. 1, figs. 1–3; pl. 2, figs. 1–11. Not von Drasche, 1883, p. 15.

Botrylloides tyreum Herdman, 1886, pp. 344, 381.—Gottschaldt, 1898, p. 642.—Sluiter, 1904, p. 101.—Van Name, 1918, p. 111, fig. 67.

MATERIAL EXAMINED

Palau Islands: Barrier reef 8 mi. NW. of Koror Island; GVP sta. 25. One colony (USNM 11378).

Description.—A small, 7 mm.×7 mm. piece of colony from the Palau Islands was examined, it contained several zooids embedded in the test, situated obliquely.

Test hard, gelatinous, thin but very tough, translucent, milky white. Many embedded small purplish-brown ampullae scattered near surface of colony, some especially minute and arranged regularly in a circle around each branchial aperture (fig. 62a). Zooids up to 3.5 mm. in length. Anterior part of body surrounding plainly margined

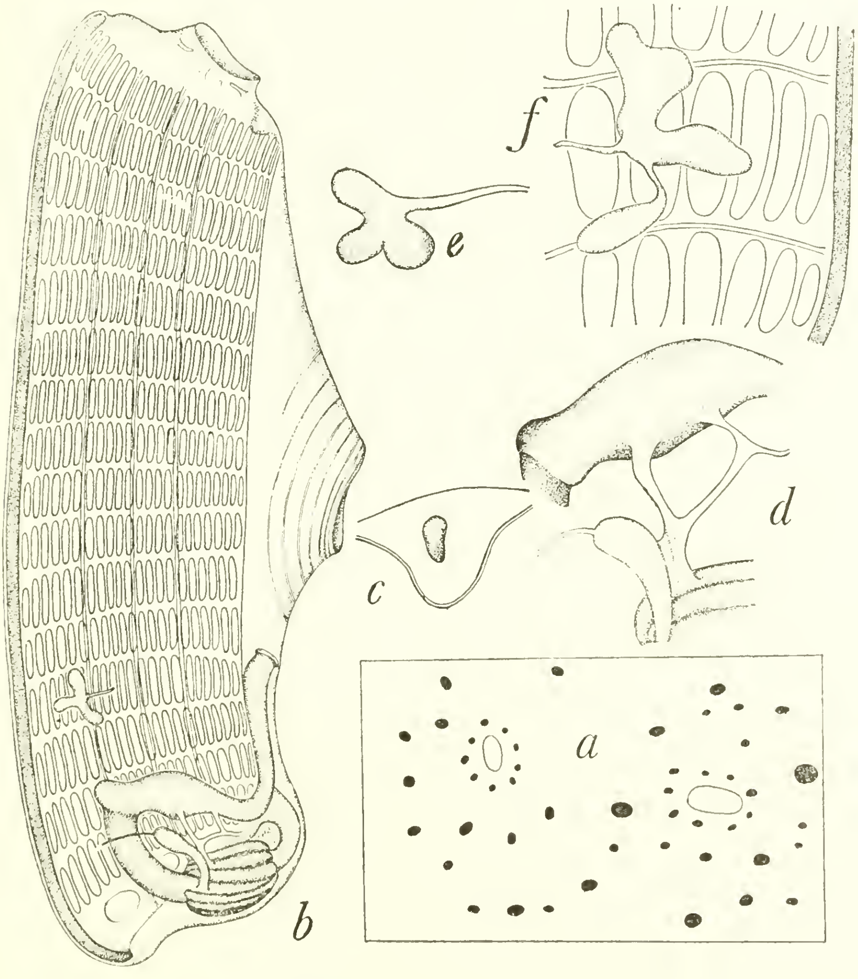

Figure 62.—*Botrylloides tyreum* Herdman: *a*, part of colony surface showing arrangement of pigmented ampullae; *b*, left side of zooid; *c*, ciliated groove; *d*, pyloric caecum and vessels connecting it with proximal portion of rectum; *e*, left testis; *f*, right testis.

branchial aperture pigmented dark purplish black, ventral side of anterior half of body also stained fairly deeply in same color. Transverse vessels and both sides of endostyle also pigmented. Atrial aperture opens slightly posterior to middle of dorsal side of body. Stigmatal rows 17–19 on right, 18–20 on left side; all rows reach median line dorsally, last row rudimentary. Stigmata arranged (D=dorsal, V=ventral): D 6–8 (1) 4–5 (1) 5 (1) 6 V. Tentacles about 8, ciliated groove an elongated elliptical aperture (fig. 62*c*). Alimentary canal comparatively small. Posterior half of stomach exposed beyond posterior margin of branchial sac; stomach orange, with 11 longitudinal plications on surface. Pyloric caecum elongated, arrangement of vessels near caecum unique (fig. 62*d*). Middle intestine remarkably long, covered with faintly pigmented epithelium, passes to whitish intestine, forming a sharp angle at junction. Proximal part of intestine fairly swollen. Anterior margin of intestinal loop reaches 14th transverse vessel. Second intestinal loop rather distinct, axis passes through esophageal region. Anus opens at level of 12th transverse vessel, plainly margined. Small testis in ventral half of each side, situated at level of 13th stigmatal row, consisting of three lobules in earlier stages.

REMARKS.—Zooids of the present specimen are larger than those of typical *Botrylloides tyreum*, which are up to 2 mm. in length, while the alimentary canal seems to be comparatively smaller in the present specimen than in the typical form. These differences are, however, not to be considered of a special significance.

78. *Botrylloides violaceus* Oka

FIGURE 63

Botrylloides violaceum Oka, 1927b, p. 608.—Tokioka, 1949a, p. 7, pl. 3, figs. 5–6.—Tokioka, 1951a, p. 10, fig. 8.—Tokioka, 1951b, p. 173.—Tokioka, 1953a, p. 241, pl. 3, figs. 1–2; pl. 44, figs. 1–5; pl. 45, figs. 1–4.

MATERIAL EXAMINED

JAPAN: Hokkaido, Hakodate; E. S. Morse, coll. Two colonies (USNM 11693).
PALAU ISLANDS: Ngemelis Island, seaward reef flat; GVF sta. 61. One colony attached to coralline alga (USNM 11391).

DESCRIPTION.—Two colonies from Japan and a small piece of colony from the Palau Islands were examined. The Japanese specimens are respectively 60 mm. × 25 mm. and 80 mm. × 35 mm. in extent and 2 mm. in thickness, and are encrusting gravels. They are reddish brown; testicular follicles 4 to 9 in examined zooids; 9 plications on stomach, besides typhlosolis.

The Palau specimen is somewhat problematical. A small, 4 mm. long piece, containing only three immature zooids about 2 mm. in length, purplish brown in color, embedded in the test, each inclined and opened to exterior independently. Very probably zooids open to common cloacal canal of elongated systems when colony grows up

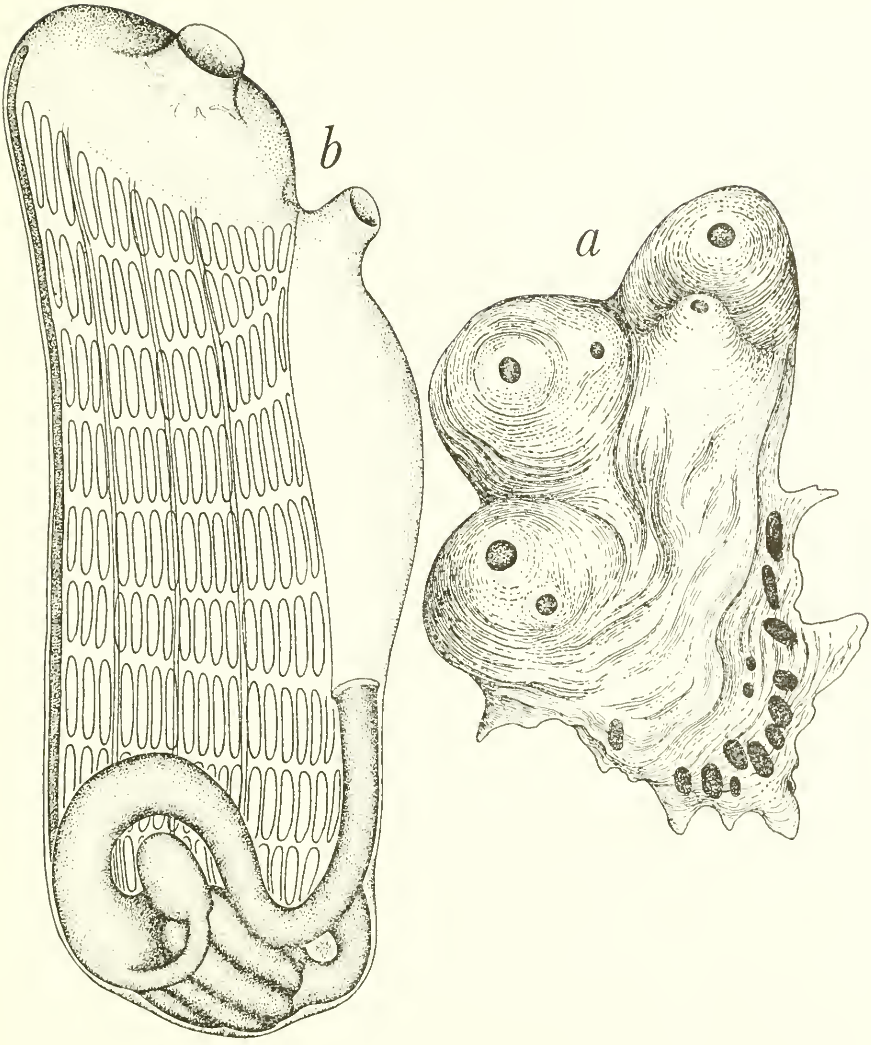

FIGURE 63.—*Botrylloides violaceus* Oka: *a*, small piece of colony from the Palau Islands; *b*, left side of zooid from same.

and zooids increase in number. Stigmatal rows 10 on left, 11 on right side. Usually dorsal edge of second row does not reach median line, as example, in one zooid it falls the distance of four stigmata from the median line on the right side; exceptionally it may reach the dorsomedian line, as on left side of another examined zooid. Posterior-most row rather rudimentary. Stigmata arranged (D=dorsal, V=ventral) : D 4–6 (1) 3–4 (1) 3–4 (1) 3 V. Tentacles 8, larger and smaller ones alternate regularly. Ciliated groove an oval orifice. Anterior margin of intestinal loop reaches seventh transverse vessel, second intestinal loop very distinct, axis passes near cardiac end of stomach lying horizontally, nearly exposed behind branchial sac and having 11 longitudinal plications, including typhlosolis. Pyloric caecum very prominent. Anus situated at level of sixth to seventh transverse vessel, plainly margined. Mantle and transverse vessels of branchial sac pigmented purplish brown. Appearance of second stigmatal row, which does not reach dorsomedian line, and situation of anus seem to indicate the present small specimen assignable to a young colony of *Botrylloides violaceus* Oka.

Remarks.—*Botrylloides leachi* (Savigny), *Botrylloides chevalense* Herdman, and *Botrylloides diegensis* Ritter and Forsyth resemble very closely *Botrylloides violaceus* Oka, and I am inclined to consider that all of these four species might be treated under a single species, *B. leachi*. However, until more crucial comparative studies are made as to the appearance of the second stigmatal row and the situation of the anus in these species, I wish to retain the name *B. violaceus* for the form occurring in the western part of the North Pacific.

79. *Botrylloides violaceus marginatus*, new subspecies

Figure 64

Holotype.—USNM 11447: Palau Islands; east reef, about 1¾ mi. south of Ngaremdiu, at end of reef called Uchulachei, east side of Urukthapel; 7°13′05″ N., 134°26′30″ E. (HO chart 6078, 1st ed.); depth 0–20 ft., coral with patches of sand. GVF sta. 227, October 15, 1955.

Paratype.—USNM 11455: Palau Islands; outer reef at eastern end of Urukthapel Island, about 1½ mi. north of Pkulasuch Point; 7°16′13″ N., 134°27′35″ E. (HO chart 6076, 2nd ed.); depth 2–4 feet, in breakers; bottom covered with *Turbinaria*. GVF sta. 28, July 21, 1955.

Description.—Two encrusting colonies from the Palau Islands are described: one is very extensive and consists of three lobes respectively 25 mm. × 20 mm., 25 mm. × 18 mm., and 20 mm. × 15 mm. in extent and 2 mm. in thickness, while the other colony is much smaller and narrower, only 34 mm. × 8 mm. in extent.

Test faintly milky white and transparent; a number of small, elongated, purplish brown ampullae, which appear roundish when seen from surface, scattered in test. Systems elongated, largest in present specimens consists of 73 zooids. Several roundish, common cloacal apertures in each larger system. Zooids about 2 mm. in length, situated nearly perpendicular or slightly inclined, reddish brown or purplish brown. Coloration darkest at anterior side of thorax surrounding branchial aperture, but fades on lateral side of body and on atrial languet. Systems yellowish orange along axial parts, while periphery heavily pigmented purplish or dark brown when animals

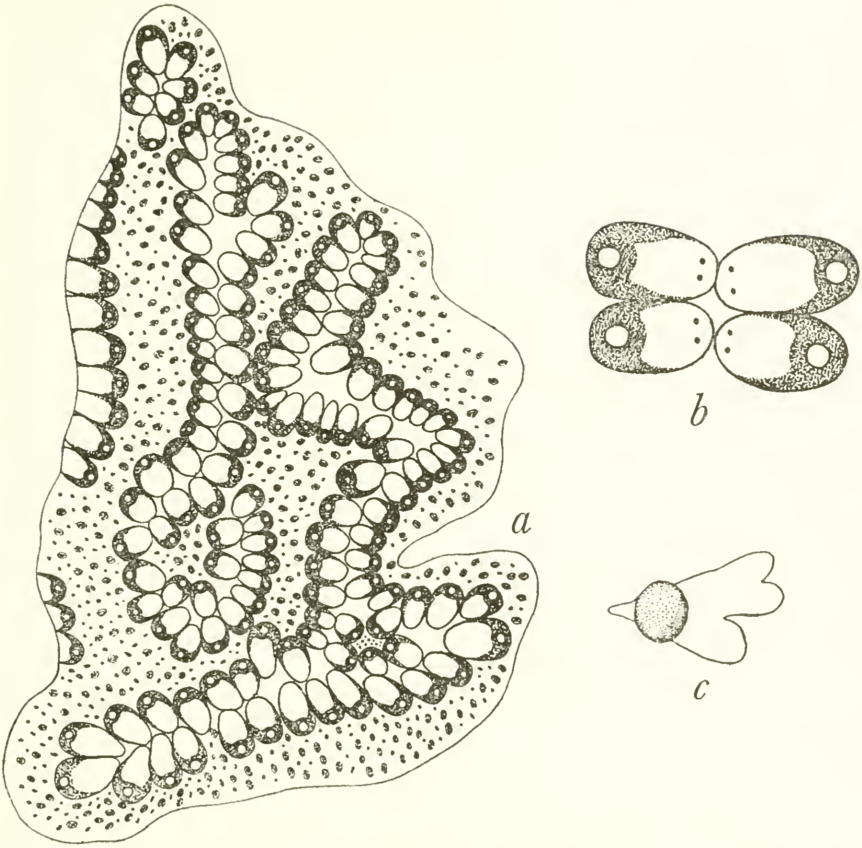

Figure 64.—*Botrylloides violaceus marginatus*, new subspecies: *a*, lobe of larger colony; *b*, two pairs of zooids from a system; *c*, small gonad on right side.

are alive (fig. 64*a*). Usually a pair of yellowish pigments near distal end of atrial languet (fig. 64*b*). Stigmatal rows 12–14 on right, 12–13 on left side, posterior-most row often rudimentary. Dorsal edge of second row does not reach median line. From 8 to 9 rows exposed through a huge atrial opening. Up to 15 stigmata in each row on each side of body; arranged roughly (D=dorsal, V=ventral): D 3 (1) 4 (1) 3 (1) 4 V. Tentacles 8, larger and smaller ones alternate regularly. Ciliated groove a minute oval opening. Situation of anterior margin of intestinal loop varies from 12th transverse vessel to middle of 11th stigmatal row; that of anus fluctuates from 11th to 10th transverse vessel. Stomach located behind branchial sac, with 8 longitudinal plications besides typhlosolis. Some zooids from smaller colony have small gonads situated near middle of body at level of posterior margin of branchial sac, just at position of cardiac end of stomach on right side, and at level of 10th transverse vessel on ventral left side, just along anterior margin of intestinal loop.

Remarks.—The structure of zooids in the present colony closely resembles that of the typical form of *Botrylloides violaceus* Oka. However, from my own observation, the coloration found in these specimens seems to be unique and rather constant. Moreover, the anus is located more posterior in the present specimens than in the typical form in which the anus opens at the level of the ninth to sixth transverse vessel. Because of the existence of these characteristics I prefer at present to treat these specimens as a subspecies of *B. violaceus.*

Family Styelidae

80. *Symplegma viride* Herdman

Figure 65

Symplegma viride Herdman, 1886, p. 144, pl. 18, figs. 7–14.—Van Name, 1902, p. 378, pl. 50, fig. 22.—Michaelsen, 1904, p. 23.—Van Name, 1921, p. 404, fig. 75.—Van Name, 1930, p. 482, figs. 50–51.—Berrill, 1932, pp. 78, 86, 88, figs. 5b, 5d, 5e.—Berrill, 1940, p. 272, figs. 1–5.—Van Name, 1945, p. 232, fig. 139, pl. 18, fig. 2.—Millar, 1953, p. 315, fig. 21.—Millar, 1955, p. 196, fig. 24.—Millar, 1956, p. 925.

Diandrocarpa botryllopsis Van Name, 1902, p. 383, pl. 54, fig. 68; pl. 59, figs. 120–121; pl. 60, fig. 123.—Michaelsen, 1904, p. 43.

Diandrocarpa brakenhielmi Michaelsen, 1904, p. 50.

Diandrocarpa brakenhielmi var. *ceylonica* Herdman, 1906, p. 331, pl. 7, figs. 10–18.

Symplegma viride brakenhielmi Van Name, 1921, p. 407, fig. 76.

Symplegma viride f. *brakenhielmi* Hartmeyer & Michaelsen, 1928, p. 358.

MATERIAL EXAMINED

China: Probably Amoy; received October 12, 1932, from T. Y. Chen, University of Amoy; sta. 5, no further data. One colony (USNM 11535).

Thailand: Langsuen; encrusting barnacles on a bamboo stake. H. M. Smith, September 22, 1923. One colony (USNM 11762).

Palau Islands: Ngemelis Island; seaward reef flat. GVF sta. 61. One colony (USNM 11390).

Description.—A small colony from the Palau Islands, a single massive colony, 25 mm. long and 10 mm. × 5 mm. on section near the middle, from Amoy and a comparatively large encrusting colony, 37 mm. × 21 mm. in extent and about 1 mm. in thickness, from Thailand were examined. The Palau specimen includes only two zooids, respectively 2 mm. and 3 mm. in length.

Test transparent, vessels, and many ampullae full of yellowish corpuscles seen distinctly through test. Up to 30 vessels mostly running in dorsoventral direction and anastomosing with one another cover periphery of zooid. Amoy specimen sparsely covered with mud; test transparent, gelatinous, somewhat horny to touch. Zooids about 2 mm. in length and yellowish brown. The Thai colony contains 2.5 mm.–4 mm. long zooids, test transparent.

Zooids laid with left ventral side beneath. Branchial aperture subterminal, anterior margin of atrial aperture situated at middle of

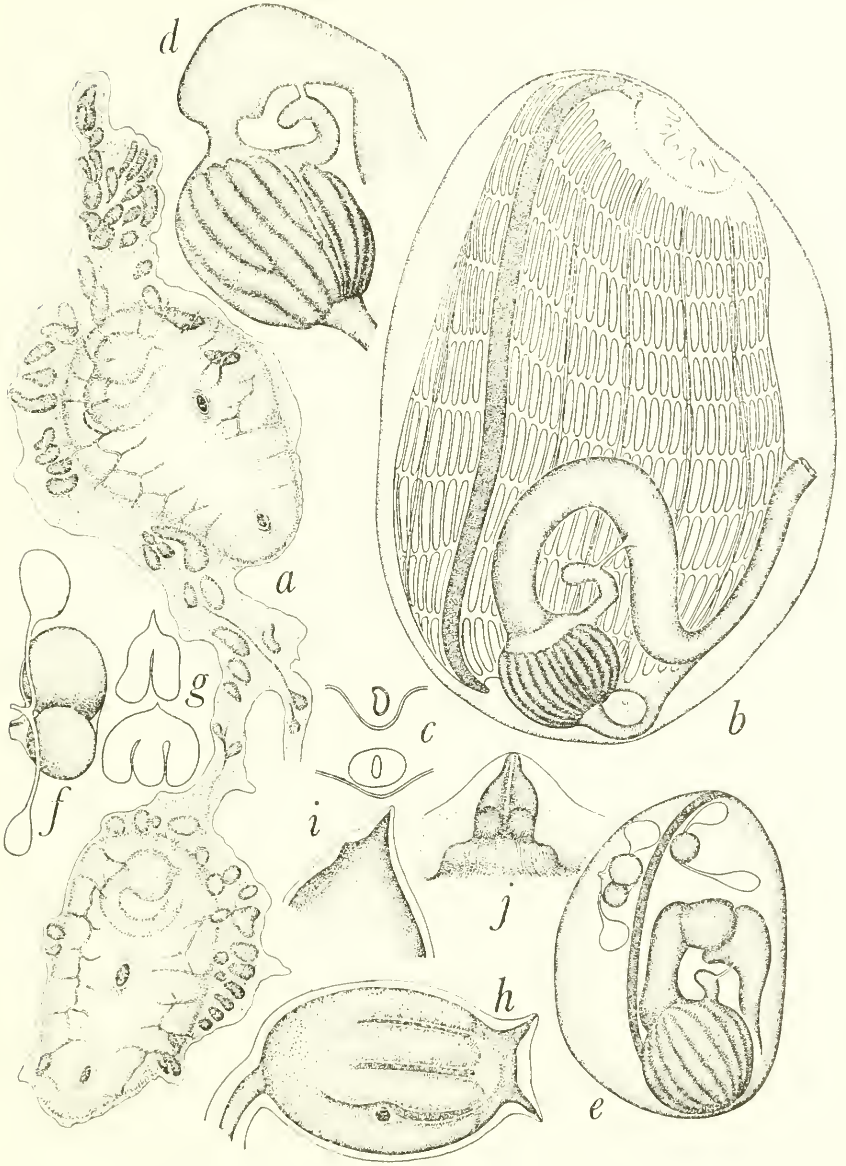

FIGURE 65.—*Symplegma viride* Herdman: *a*, small colony from the Palau Islands; *b*, left ventral side of a zooid from same; *c*, ciliated grooves; *d*, stomach with elongated pyloric caecum, Thai specimen; *e*, left ventral side of a zooid, Amoy specimen; *f*, gonad of same zooid; *g*, lobated testicular follicles, Thai specimen; *h*, trunk of larva from Amoy specimen; *i*, side view of anterior end of same; *j*, tip of attachment process.

body. Both apertures slightly elongated along longitudinal axis of body. Fine atrial tentacles present. Mantle musculature consists of about 40 fine muscles running in dorsoventral direction and several transverse ones crossing the former at right angles. Stigmatal rows

9 in Palau specimen, 9 (left)–10 (right) in Amoy specimen, and 10–12 in Thai specimen. Dorsal edge of second row falls in distance of about 4 stigmata to median line. Stigmata are arranged (D=dorsal, V=ventral): D 4–7 (1) 3–6 (1) 3–7 (1) 4–6 (1) 4–7 V. Parastigmatic vessels absent. Tentacles vary remarkably in number according to locality, probably also to condition of preservation or degree of contraction; only 9 in Palau specimen, 12 in Thai specimen, but very slender and up to 39 in Amoy specimens. Probably small or minute tentacles become indistinct in a strongly contracted state. Ciliated groove a small elongated opening.

Anterior margin of intestinal loop usually reaches near fifth transverse vessel, although it may approach fourth transverse vessel in Amoy specimen. Second intestinal loop deep and wide, axis passes through esophageal region. Anus situated at level of seventh transverse vessel (in the Thai specimen), middle of fifth stigmatal row; margin thickened but plain. Stomach globular, usually half as long as intestinal loop, with a number of longitudinal plications on surface, 19 in Palau specimen and 11–13, besides typhlosolis, in Thai specimen. Pyloric caecum long and very distinct, curves strongly towards left in C shape, a vessel connecting caecum to proximal portion of rectum leaves caecum at level of its distal one-third. Cardiac half of stomach exposed behind branchial sac. Distinction between hind stomach and middle intestine not clear (figs. 65*b*,*d*) in the Palau and Thai specimens, but somewhat clear in Amoy specimen (fig. 65*e*). Testicular lobe mostly simple (figs. 65*e*, *f*) in shape in present specimens, although may be bifid or trifid in some zooids (fig. 65*g*).

Larval trunk 550–600μ in length, ellipsoidal in shape; tail approximately 900μ in length and 250–300μ in breadth, measuring on fin; chorda about 700μ in length. Four pairs of elongated ampullae seen rather faintly on trunk. Three attachment processes present, two dorsal ones prominent, ventral one rudimentary (fig. 65*i*). Pigment fleck of sensory organ situated near middle of body.

REMARKS.—There are five species of Polyzoinae in the warm water region of the Western Pacific which resemble one another very closely. They are characterized by possessing only a few inner longitudinal vessels in place of branchial folds; a single hermaphroditic gonad on each side of the body, which consists of a pair of testicular lobes and a median ovary; and in forming the encrusting colony. These forms are, however, distinguishable from one another by the following characteristics:

Inner longitudinal vessels 3 on each side . . . 1. **Botryllocarpa viridis** (Pizon)
Inner longitudinal vessels 4 on each side:
  Pyloric caecum elongated and curved, a vessel connects distal one-third of the caecum with intestine. (Stigmatal rows 9–12, longitudinal plications on stomach 11–19) . . . . 2. **Symplegma viride** Herdman

Pyloric caecum elongated, but not so strongly curved as in *S. viride;* two vessels issue from distal end of caecum and branch in a complicated way, also one connecting anteroproximal side of caecum to intestine. (Stigmatal rows 12–14, longitudinal plications on the stomach 13.
3. Symplegma oceania Tokioka

Pyloric caecum short and stout, a vessel connects distal end of caecum with intestine. (Stigmatal rows 7–9, longitudinal plications on the stomach about 10) . . . . **4. Symplegma reptans** (Oka)

Pyloric caecum indiscernible, a vessel connects inner pyloric corner of stomach with intestine. (Stigmatal rows 8–11, up to 13 longitudinal plications on stomach) . . . . **5. Symplegma connectens** Tokioka

S. reptans and *S. connectens* resemble each other in the structure of the larva; larva differs distinctly from those of *S. viride* and *S. oceania.* In the first two species, the larva has three distinct attachment processes and the pigment fleck of the sensory organ situated in the posterior half of the trunk, but no elongated ampullae defined distinctly; while in *S. viride*, the ventral one of three attachment processes is nearly rudimentary and the pigment fleck is located near the middle of the trunk. The larva of *S. oceania* has three distinct attachment processes and usually 16 elongated ampullae are fairly well defined on the trunk.

81. *Stolonica styeliformis* Van Name

FIGURE 66

Stolonica styeliformis Van Name, 1918, p. 107, figs. 61–63; pl. 29, figs. 17–19.

MATERIAL EXAMINED

PHILIPPINE ISLANDS: Off Jolo Light; 20 fathoms. *Albatross* sta. 5174 (the type locality and station). Hundreds of specimens (USNM 11634).

DESCRIPTION.—Many individuals are crowded on a 30 cm. long gorgonian colony. Body roughly ellipsoidal in shape, attached to the creeping stolon by posterior end, 17–25 mm. in length. Branchial aperture terminal, atrial aperture situated slightly posterior to branchial; both apertures 4-lobed. Test leathery, yellowish brown, thin but tough. Surface covered sparsely with coarse sand grains, grooved considerably in anterior one-third and wrinkled in posterior two-thirds of body. Four purplish brown color bands run anteroposteriorly, converging at branchial aperture, also one or two color bands extend from anterodorsal part of body between both apertures to posterior end of body. Five or six color bands discriminated in all, but they may be rather irregular or even obscure in some specimens. A few individuals harbor small bivalves (*Marmollaria* sp.) in test. Mantle rather thick, strong in consistency and yellowish brown. On inner surface on each side 10–20 endocarps found. Fine atrial tentacles present. Usually three strong, tendon-like fascicular appendages issue from posterior end of body.

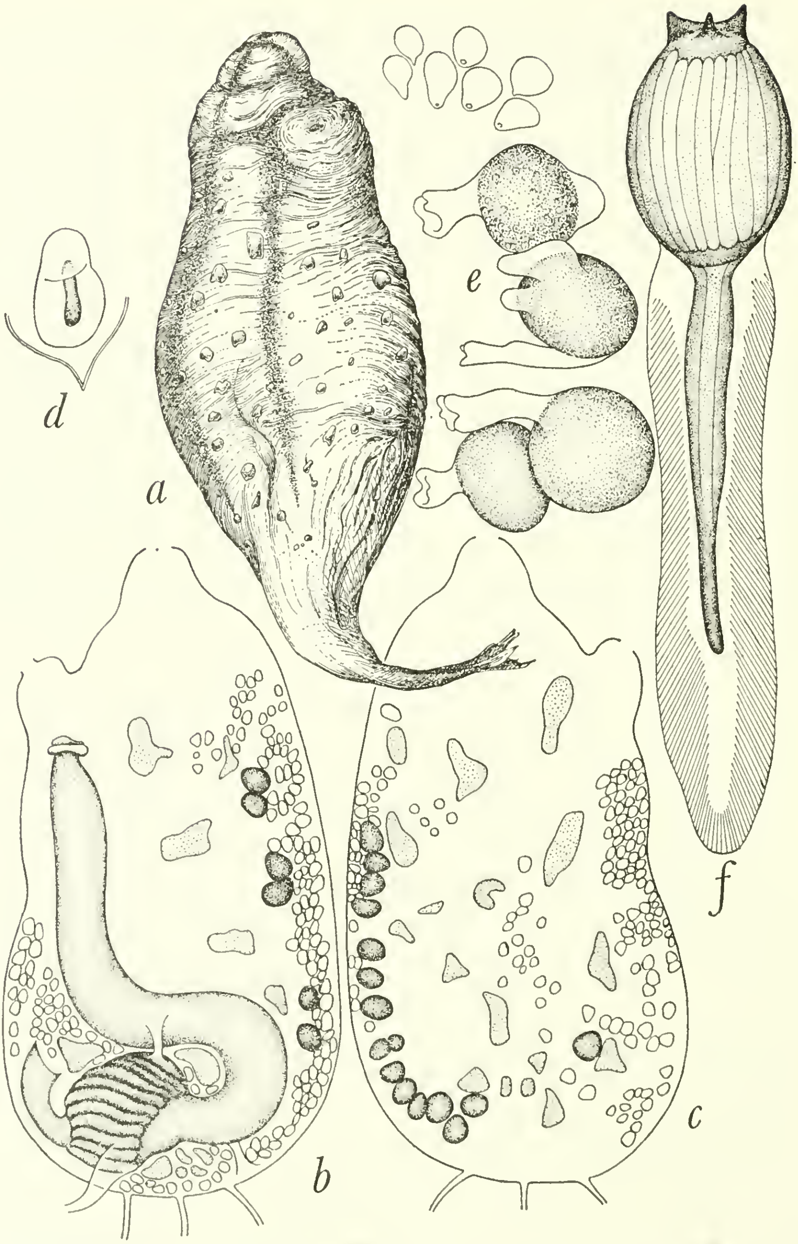

Figure 66.—*Stolonica styeliformis* Van Name: *a*, single individual, left side; *b*, left half of mantle body, inner side; *c*, right half of same; *d*, ciliated groove; *e*, testes (above) and ovaries (below); *f*, larva.

In branchial sac approximately 30 stigmatal rows (28 in one examined specimen) and two plications on each side. Inner longitudinal vessels arranged as follows (D=dorsal, V=ventral):

Left	D	4	(18)	6	(15)	8	V
Right	D	5	(15)	9	(13)	11	V

Transverse vessels and parastigmatic vessels alternate regularly; 3 stigmata in each ordinary mesh, but up to 6 or 8 in meshes along endostyle; stigmata elongated. Tentacles about 20, larger and smaller ones differentiated. Ciliated groove an elongated longitudinal slit. Second intestinal loop very shallow, axis passes through cardiac portion of stomach; rectum rather long; anal margin thickened, but plain. Stomach roughly globular with about two dozen longitudinal plications on surface; no pyloric caecum. An endocarp enclosed in first intestinal loop. In specimens examined, 6–16 ovaries and 210–273 testes found on each side. Testes small oval follicles; ovaries much larger than testes and generally each contain a single ovum; margin of aperture of oviduct undulating.

Up to 23 very large larvae in each dissected specimen. Trunk oval in shape, up to 1.2 mm. in length, tail attains 3 mm. in length; thus total length of larger larvae may attain 4.2 mm. Three attachment processes arranged in triangle. About two dozen elongated ampullae faintly discerned on surface, all very long, covering nearly entire trunk.

82. *Polyandrocarpa (Eusynstyela)* sp. aff. *monotestis* Tokioka

FIGURE 67

Polyandrocarpa (*Eusynstyela*) *monotestis* Tokioka, 1953a, p. 247, pl. 48, figs. 1–7.

MATERIAL EXAMINED

CHINA: Probably Amoy; received October 12, 1932, from T. Y. Chen, University of Amoy; sta. 3, no further data. One colony (USNM 11536).

DESCRIPTION.—A single massive colony, 33 mm. × 17 mm. in extent and 7 mm. in height. Probably an encrusting colony enclosing something wholly within the mass, the real thickness of the layer of a single row of zooids may be about 4 mm. Test gelatinous, tough, opaque and milky white. Surface finely wrinkled, carrying a small amount of mud and divided into a number of elliptical areas 3–4 mm. in length, on each of which branchial and atrial apertures of respective zooids are opened; both apertures 4-lobed. Zooids situated slightly inclined towards ventral side, about 5 mm. in length when taken out of test and freely expanded. Branchial aperture terminal, posterior margin of short atrial siphon situated at middle of body. Mantle delicate, pale yellowish brown. About 10 small endocarps on inner surface of mantle on each side. Fine tentacles present on atrial velum. Four branchial folds on each side, of which second and fourth do not form

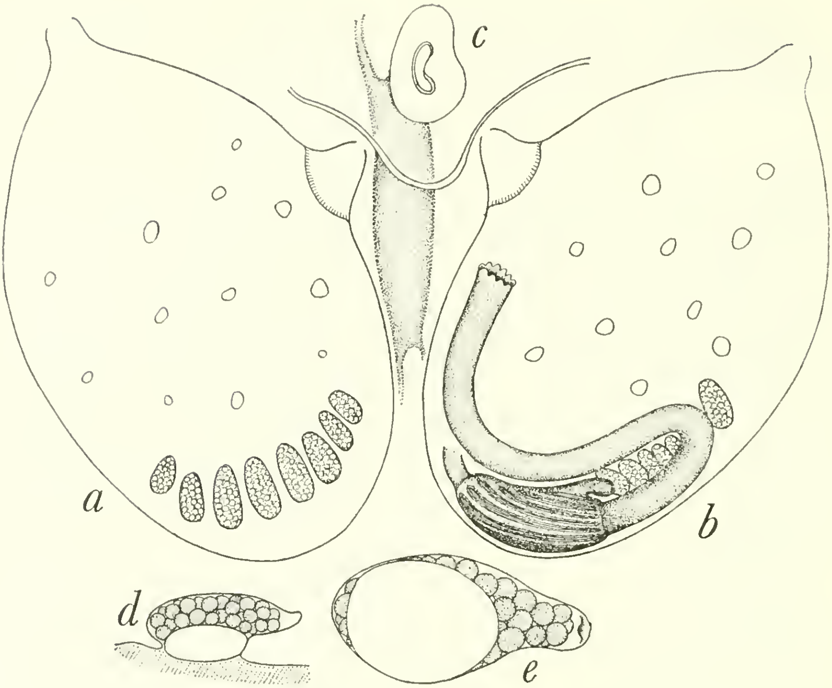

Figure 67.—*Polyandrocarpa* (*Eusynstyela*) sp. aff. *monotestis* Tokioka: *a*, right half of mantle body, inner side; *b*, left half of same; *c*, dorsal tubercle; *d*, optical section of gonad attached to body wall; *e*, attachment surface of a gonad.

a perfect fold but are represented by gathered vessels. Inner longitudinal vessels arranged (D=dorsal, V=ventral):

Left	D	0	(6)	1	(2)	1	(6)	1	(4)	0	V
Right	D	0	(9)	0	(3)	1	(7)	0	(4)	0	V

Thicker and thinner transverse vessels alternate regularly, also parastigmatic vessels at some parts of branchial sac. Usually 3 or 4 elliptical stigmata in each mesh, but may be up to 14 in larger meshes along right side of dorsal lamina edged plainly. Tentacles very slender and numerous, up to 75 in examined zooids. Ciliated groove a short longitudinal slit. Second intestinal loop very wide, its axis passes through cardiac end of stomach which is elongated, about half as long as ventral branch of first intestinal loop, a distinct pyloric caecum and 16–17 longitudinal plications on surface. Esophagus short. Anal margin plain or thickened, forming two lips, or undulating and forming a number of lobules, up to a dozen in some zooids. From 6 to 8 elliptical gonads on each side. Each gonad attached to body wall by its posterior half, just at surface of testis (fig. 67*d*), which is represented by a single oval follicle (fig. 67*e*).

Remarks.—Although there are a few differences between the present specimen and *Polyandrocarpa* (*Eusynstyela*) *monotestis* Tokioka from Sagami Bay, Japan (in the latter, the stomach is comparatively larger and with 14 longitudinal plications; tentacles are fewer, 35–40; the fourth branchial fold is represented by a fold), they agree with each other so well in the general appearance of the zooid, especially in the structure of the gonad containing a single testicular lobe. For this reason, I prefer to treat the present specimen as a form affined to *P.* (*E.*) *monotestis*, although it is not impossible that the present specimen might represent a local variety or form.

83. *Polycarpa aurata* (Quoy & Gaimard)

FIGURE 68

Ascidia aurata Quoy & Gaimard, 1834, p. 559, pl. 3.

Polycarpa aurata Sluiter, 1904, p. 57.—Herdman, 1906, p. 318, pl. 5, figs. 1–6.—Hartmeyer, 1919, p. 40, pl. 1, figs. 17–18.—Hastings, 1931, p. 74.—Tokioka, 1955b, p. 53, fig. 3; pl. 6, figs. 17–20.

Pandocia aurata Van Name, 1918, p. 94, figs. 47–48; pl. 25, figs. 5–6.

Polycarpa sulcata Herdman, 1882, p. 179, pl. 23, figs. 9–13.—von Drasche, 1884, p. 379, pl. 6, fig. 12; pl. 7, figs. 1,2,2a.—Traustedt, 1885, p. 48.

Styela psoloessa Sluiter, 1890, p. 337.

Styela (Polycarpa) pneumonodes Sluiter, 1895, p. 179, pl 10, figs. 1–3.

Polycarpa aurata var. *plana* Herdman, 1899, p. 51, pl. Cyn. 20, figs. 1–5.

Polycarpa pedunculata Pizon, 1908, p. 216, pl. 12, figs. 21–24.

MATERIAL EXAMINED

CAROLINE ISLANDS: Ifaluk Atoll; lagoon shore off middle of Ella Islet, 1½ fath., collected by diver Tawaitiu, October 21, 1953. F. M. Bayer, no. 714. One specimen attached to coral (USNM 11748).

DESCRIPTION.—The individual examined is 89 mm. in length. Test leathery, reaching about 3 mm. in thickness at some parts, very tough,

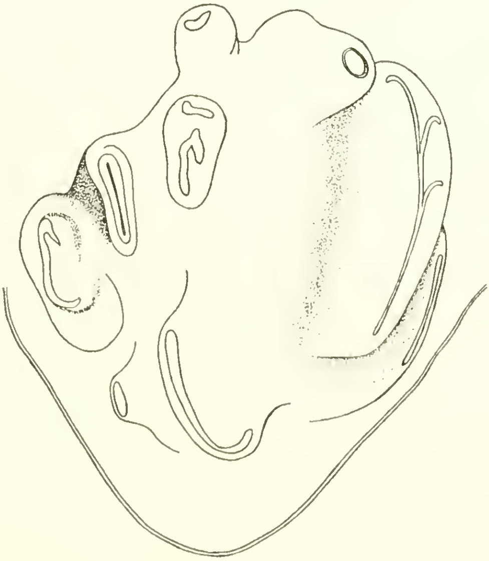

FIGURE 68.—*Polycarpa aurata* (Quoy & Gaimard): Dorsal tubercle of the 89 mm. specimen.

dark yellowish, inner surface whitish. Three remarkable longitudinal grooves on surface on each side. Outer side of mantle grayish yellow brown, inner side and viscera dark brownish. Arrangement of inner longitudinal vessels of branchial sac (D=dorsal, V=ventral):

Left	D	4	(21)	8	(24)	9	(23)	7	(19)	9	V
Right	D	5	(22)	7	(23)	8	(23)	6	(16)	4	V

Transverse vessels arranged (numerals represent order of thickness): 1 3 3 3 2 3 3 3 1. Parastigmatic vessels absent, 10–15 stigmata in each mesh. Tentacles 26, larger and smaller ones discernible. Ciliated groove abnormal in appearance (fig. 68). Many amphipods found in branchial sac.

84. ?*Polycarpa quadrata* Herdman

FIGURE 69

Polycarpa quadrata Herdman, 1882, p. 173, pl. 22, figs. 8–10.—Traustedt, 1885, p. 48.—Tokioka, 1952, p. 123, fig. 21.

Styela quadrata Sluiter, 1904, p. 126.

Pandocia quadrata Van Name, 1918, p. 99, figs. 50–52; pl. 31, fig. 34.

MATERIAL EXAMINED

PALAU ISLANDS: Iwayama Bay, east side of Oyster Pass. GVF sta. 220. Two specimens (USNM 11442).

DESCRIPTION.—Two small specimens from the Palau Islands were examined. They are 4 mm. (fig. 69*a*) and 3.5 mm. (fig. 69*b*) in length, the former accompanied by two very small individuals found attached to its surface, and the latter with a single minute individual attached to the posterior end of the body.

Body ovate or elongate-elliptical, branchial aperture terminal, atrial aperture situated near branchial. Test yellowish white, translucent, wrinkled, carries sand grains and mud on surface. Mantle rather thick, purplish brown. Atrial tentacles very distinct. Several remarkable endocarps on inner surface of mantle. In branchial sac inner longitudinal vessels arranged (D=dorsal, V=ventral):

Left	D	2	(9)	1	(10)	–	–	–	(4)	1	V
Right	D	?	(8)	1	(7)	1	(9)	1	(4)	1	V

Transverse vessels nearly of same thickness, parastigmatic vessels absent. One or two stigmata in each mesh. Tentacles 22, larger and smaller ones differentiated. Ciliated groove T-shaped. Second intestinal loop very shallow, axis passes approximately esophageal region. Stomach oval in outline, eight longitudinal plications on free surface, a caecum at inner pyloric corner. Anus divided into two lips. Gonads not yet developed.

REMARKS.—The general appearance of the alimentary canal of the present specimens shows close relationship to *Polycarpa quadrata* Herdman, though the identification is not definite, as no gonads are developed.

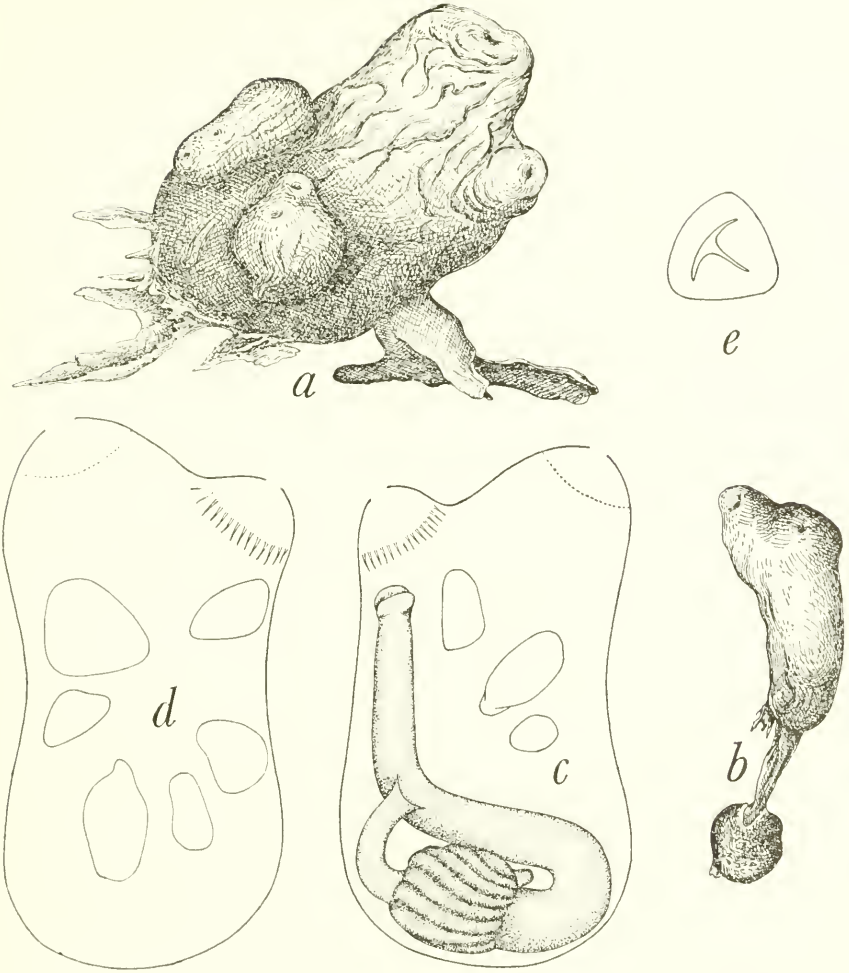

FIGURE 69.—?*Polycarpa quadrata* Herdman: *a*, 4 mm. specimen; *b*, 3.5 mm. specimen, with very small young attached to posterior end of body; *c*, left half of mantle body, inside; *d*, right half of same; *e*, ciliated groove.

85. *Polycarpa captiosa* (Sluiter)

FIGURE 70

Styela captiosa Sluiter, 1885, p. 202, pl. 9, figs. 4–7.—Sluiter, 1890, p. 333.—Sluiter, 1904, p. 60.

Polycarpa captiosa Tokioka, 1950, p. 136, fig. 14; pl. 10, fig. 1.

MATERIAL EXAMINED

PALAU ISLANDS: Iwayama Bay, west side of Island XXII. GVF sta. 135. Four large specimens (USNM 11421).

MARIANAS ISLANDS: Saipan Island, Tanapag Harbor. P. E. Cloud, sta. D–8. Two small specimens (USNM 11469).

DESCRIPTON.—Four large, 85 mm.–120 mm. long specimens from the Palau Islands and two small, 25 mm. and 8 mm. long ones from Saipan

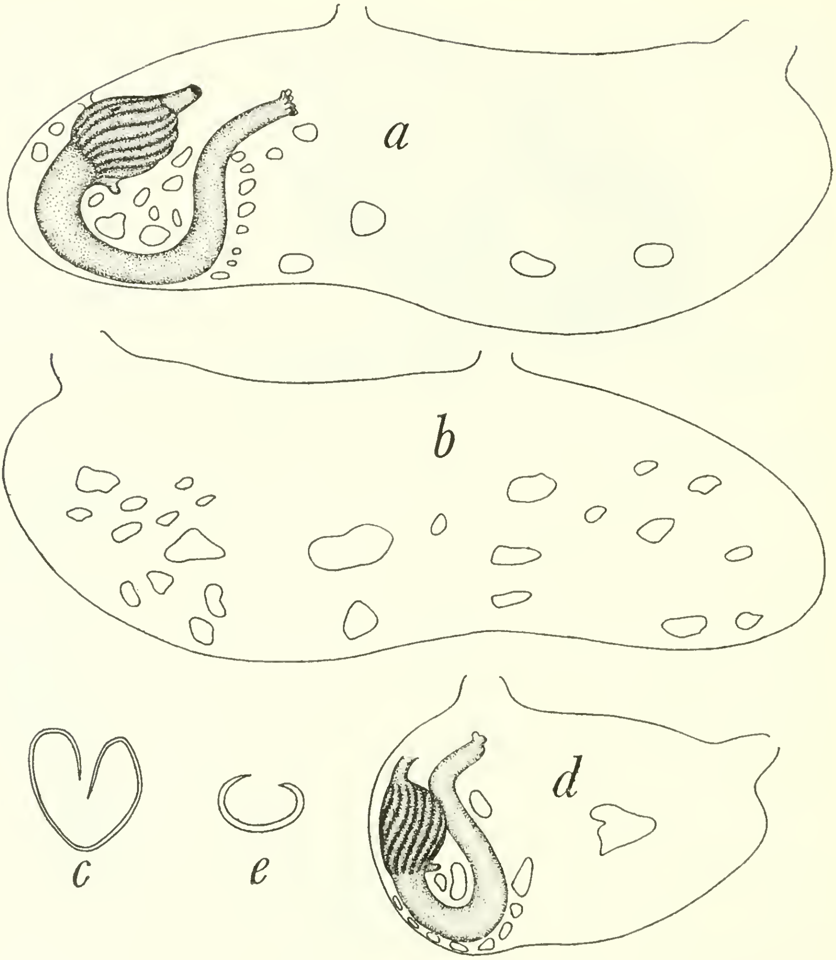

FIGURE 70.—*Polycarpa captiosa* (Sluiter): *a*, Left half of mantle body of 25 mm. individual from Saipan, inside; *b*, right half of same; *c*, ciliated groove of same specimen; *d*, left half of mantle body of the 8 mm. long specimen from Saipan, inside; *e*, ciliated groove of same.

Island were examined. The smallest (8 mm. long) individual roughly oval in outline, while other larger ones are all elongated. Branchial aperture subterminal; atrial aperture situated near middle in larger specimens, slightly posterior to middle of body in others; both apertures 4-lobed. Test leathery and tough, yellowish white in smaller Saipan specimens, but grayish red in larger Palau specimens. In smaller specimens, mantle yellowish white, very thin, delicate, adhering firmly to test and provided very sparsely with longitudinal muscles converging to apertures. Fine tentacles on atrial velum and endocarps on inner surface of mantle. Inner longitudinal vessels of branchial sac in smaller specimens are arranged (D=dorsal, V=ventral):

8 mm. long individual

Left	D	0	(10)	3	(12)	2	(11)	2	(8)	2	V
Right	D	0	(9)	2	(12)	2	(10)	3	(9)	2	V

25 mm. long individual

Left	D	0	(15)	3	(13)	3	(13)	3	(10)	3	V
Right	D	0	(10)	4	(13)	4	(13)	4	(14)	2	V

Transverse vessels alternate with parastigmatic vessels in the 8 mm. long individual or may be arranged—thick P thin P thin P thin P thick—in the 25 mm. long individual (P represents parastigmatic vessel). Four to five elongated stigmata in each mesh, although they may be up to 8 in larger meshes along endostyle. Tentacles 18 in the 8 mm. long specimen, while up to about 30 in the 25 mm. long specimen. Ciliated groove U-shaped and sometimes with incurled horns in smaller specimens. Alimentary canal located in rear part of body posterior to atrial aperture; the larger the body size, the smaller the relative size of alimentary canal. Second intestinal loop very shallow, rectum short. Stomach oval, with about 15 longitudinal plications on surface, a small caecum at inner pyloric corner. Anal margin divided into several lobules. Gonads quite immature in small Saipan specimens.

86. *Polycarpa cryptocarpa* (Sluiter)

FIGURE 71

Styela cryptocarpa Sluiter, 1885, p. 210 pl. 7, figs. 1–3.

Polycarpa cryptocarpa Hartmeyer, 1906, p. 17.—Hastings, 1931, p. 75.—Tokioka, 1950, p. 139, figs. 16–17; pl. 10, figs. 2–3.

MATERIAL EXAMINED

PALAU ISLAND: Iwayama Bay, east side of Oyster Pass. GVF sta. 220. Two specimens (USNM 11411).—Iwayama Bay, mouth of Oyster Pass. GVF sta. 236. One specimen (USNM 11422).—Fringing reef of small island in lagoon (Meharehar of Eil Malk. GVF sta. 252. One specimen (USNM 11433).

SOLOMON ISLANDS: New Georgia Island; cliff 5 ft. below surface, near Munda Airport. W. G. Iltis, sta. 38, October 17, 1944. One specimen (USNM 11522).

GILBERT ISLANDS: Onotoa Atoll; P. E. Cloud, sta. GOC 51. Four specimens (USNM 11510).—Onotoa Atoll; P. E. Cloud, sta. GOC–55. Two specimens (USNM 11509) and one specimen (USNM 11513).—Onotoa Atoll; A. H. Banner, coll., July 29, 1951; depth, 10–20 ft. Three specimens, attached to dead coral (USNM 11519).

MARSHALL ISLANDS: Bikini Atoll; lagoon, 180–200 ft. L. P. Schultz, sta. S–46–44, March 29, 1946. One specimen (USNM 11764).

DESCRIPTION.—A total of 18 specimens were dissected for examination. The largest is 80 mm. in length. Body somewhat compressed laterally as shown in following measurements: 75 mm. in length, 50 mm. in width, 20 mm. in lateral thickness. Animals usually attached to substratum by posterior part of body, which may rarely be prolonged into a peduncular protuberance, as is seen in a 35 mm. long specimen from the Gilbert Islands, in which the posterior portion of

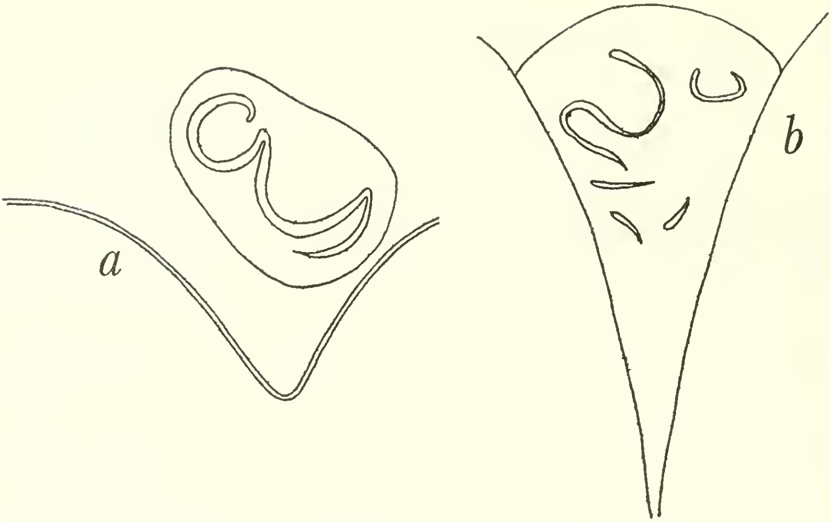

FIGURE 71.—*Polycarpa cryptocarpa* (Sluiter): Simple ciliated grooves of the specimens from *a*, the Solomon Islands and *b*, Bikini Island.

the body is extended into a 15 mm. long peduncle. Surface generally fouled with sponges, compound ascidians, and other organisms.

Test leathery, usually brownish black or purplish black, although yellowish brown in two specimens respectively from Bikini Lagoon and the Gilbert Islands. Section and inner surface of test are whitish, grayish white, or sometimes faintly greenish or purplish. Mantle rather thick and dark brownish, brownish black or purplish black. Viscera also brownish black. Very frequently many small, 150–160μ in long diameter, oval capsules full of brownish-black pigment scattered over surface of mantle. Ciliated groove very complex in configuration, but may be rather simple in a few cases (fig. 71*a*, *b*). Gonads distributed nearly evenly over entire inner surface of mantle and buried beneath relatively thick mantle tissue, practically invisible from surface. Some specimens carry parasitic copepods or pontonid shrimps in branchial sac.

87. *Polycarpa iwayamae* Tokioka

FIGURE 72

Polycarpa iwayamae Tokioka, 1950, p. 143, fig. 18.

MATERIAL EXAMINED

PALAU ISLANDS: Iwayama Bay, west side of Kogai-hanto, Auluptagel Island; GVF sta. 100. Two specimens attached to *Spondylus* shell (USNM 11417).—Iwayama Bay, east side of Oyster Pass; GVF sta. 220. One specimen 60 mm. long (USNM 11412).—GVF sta. 220A. One specimen 55 mm. long (USNM 11415).

GILBERT ISLANDS: Onotoa Atoll; P. E. Cloud, sta. GOC-35. One specimen 20 mm. long (USNM 11494).

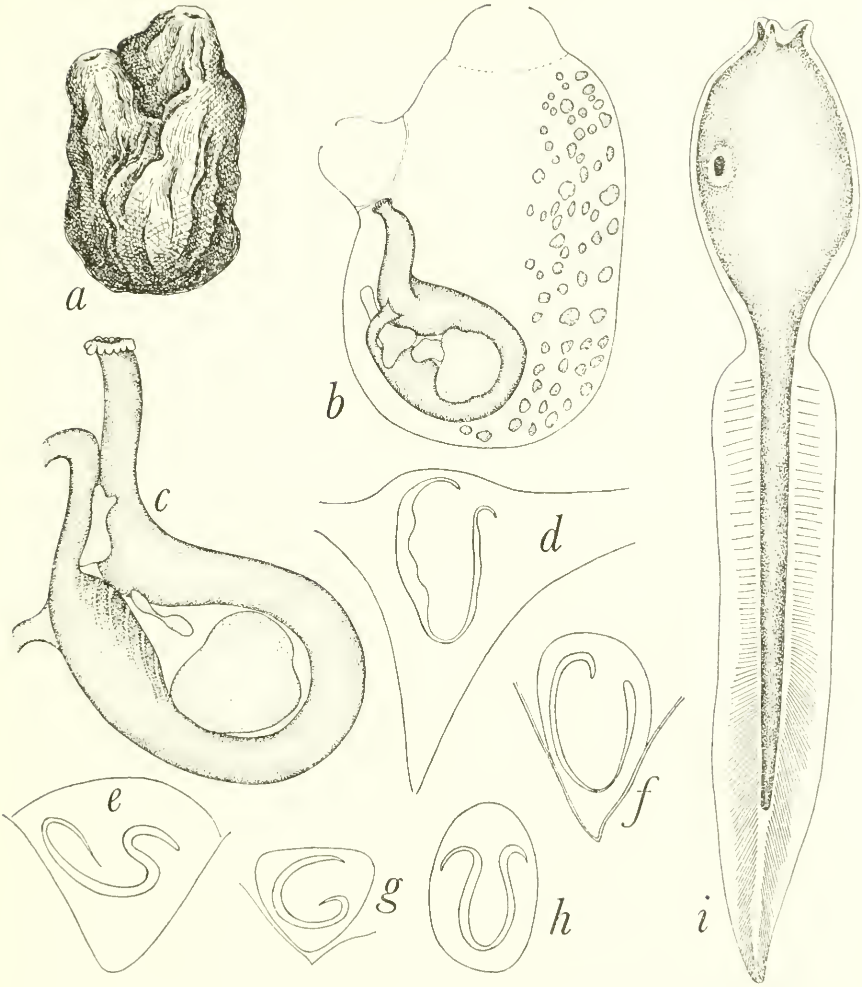

Figure 72.—*Polycarpa iwayamae* Tokioka: *a*, right side of specimen from Arno Atoll; *b*, left half of mantle body of same specimen, inside; *c*, alimentary canal of a Palau specimen; *d–h*, ciliated grooves of specimens from various localities; *i*, larva, magnified.

Marshall Islands: Arno Atoll; P. E. Cloud, sta. MAC–2. One specimen (USNM 11511).—Arno Atoll; lagoon, off Ine Village, 20–23 fath.; J. W. Wells, sta. 33, haul 2, July 21, 1950. One specimen 37 mm. long, color vermilion in life (USNM 11521).

Description.—Three specimens from the Palau Islands, two from the Marshall Islands and a single individual from the Gilbert Islands were examined. They are 20 mm. to 60 mm. in length, roughly oval in shape, and with branchial aperture at the terminal and atrial aperture opening at level of the anterior one-third of body length. Test soft, leathery but tough, rather thin in anterior part, but may reach 2 mm. in posterior part of body. Surface irregularly grooved, especially a few longitudinal grooves are prominent; frequently fouled with various organisms. Test usually grayish white or brownish, although some specimens may be as dark brownish as in *Polycarpa cryptocarpa;* inner surface grayish white and glistens. Mantle thin but tough, usually dark brownish; viscera also brownish. Minute tentacles along atrial velum.

In branchial sac inner logitudinal vessels are arranged in two larger specimens as follows (D=dorsal, V=ventral):

No. 1	Left	D	2	(11)	3	(11)	3	(11)	5	(11)	4	V
	Right	D	2	(11)	2	(9)	4	(12)	5	(11)	3	V
No. 2	Left	D	2	(6)	5	(14)	4	(13)	5	(12)	3	V
	Right	D	4	(10)	4	(12)	5	(13)	4	(10)	4	V

In 55 mm. long specimen from Palau Islands, a short low rudimentary fold was found in right posterior part of branchial sac between dorsal lamina and the first fold:—D 0 (3) 2 (10)—. Transverse vessels are arranged (numerals represent order of thickness): 1 3 2 3 1, or 1 4 3 4 2 4 3 4 1. Vessels of fourth order are replaced in some specimens with parastigmatic vessels which are, however, practically absent in some others. Stigmata 6–8 to 12–15 in each mesh, may be up to 15–20 in meshes along endostyle. Tentacles 28–31 in examined specimens, usually larger and smaller ones alternate; medium or minute ones may be differentiated in some specimens. Ciliated groove generally simply U-shaped with horns curled in or out. Second intestinal loop very shallow, axis passing through esophageal part or cardiac portion of stomach, turning portion of loop may be more or less swollen (figs. 72 *b*, *c*). Anal margin cut into 20–25 lobules. Usually one large and two smaller endocarps in first intestinal loop. Pyloric caecum absent. Gonads usually distributed in ventral one-third or half of body, most densely along endostyle; up to 85–180 on right, 67–100 on left side in examined specimens, always buried beneath thin, translucent mantle tissue, distinctly visible from surface as if quite exposed.

Tadpole larvae found in a 37 mm. long specimen from the Marshall Islands; trunk ellipsoidal, 310–350μ in length, with sensory pigment fleck nearly at middle; three attachment processes, of which two are dorsal and one ventral. Tail twice as long as trunk, tip bluntly pointed.

88. *Polycarpa psammotesta* Tokioka

FIGURE 73

Polycarpa psammotesta Tokioka, 1953a, p. 249, pl. 50, figs. 1–8.

MATERIAL EXAMINED

JAPAN: Honshu Island; off Ose Zaki, S. 34° E., 0.8 mi. *Albatross* sta. 3717. Three specimens.—Hokkaido Island; Hakodate. E. S. Morse, coll. Two specimens (USNM 11696).

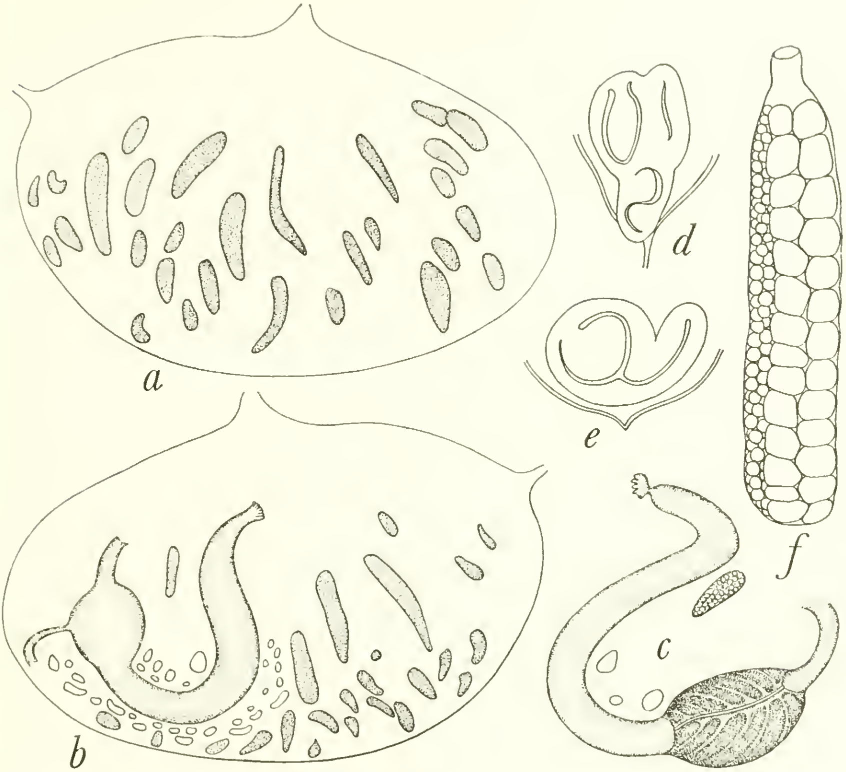

FIGURE 73.—*Polycarpa psammotesta* Tokioka: *a*, right half of mantle body of 33 mm. specimen, inside; *b*, left half of same; *c*, intestinal loop of 30 mm. specimen from Hakodate, side of attachment; *d*, *e*, ciliated grooves; *f*, large gonad, side of attachment.

DESCRIPTION.—Five specimens from Japanese waters were examined. They are ovoid in shape, 22 mm.–35 mm. in length, densely encrusted with fine sand grains all over the surface, just as in many forms of Molgulidae. In fact, it was practically impossible to distinguish this species from *Molgula* (*Molgula*) *xenophora* Oka without dissecting them—these two forms were found together in the same collection. Both apertures quite invisible on surface, although marked distinctly on inner surface of test, distance between them is 33–43 percent of body length. In some specimens sand grains encrusting dorsal side of test were finer than those encrusting ventral side.

Test thin, about 1 mm. in thickness, impregnated with sand, very fragile. Mantle yellowish or yellowish brown, very delicate; musculature feeble. Branchial aperture subterminal and atrial aperture situated near middle of body; both siphons insignificant. Small endocarps present along ventral branch of intestinal loop. Fine tentacles along margin of atrial velum. In branchial sac inner longitudinal vessels in a dissected 33 mm. long individual arranged as follows (D=dorsal, V=ventral):

Left	D	0	(20)	5	(21)	5	(21)	5	(18)	5	V
Right	D	1	(11)	5	(19)	6	(21)	6	(20)	5	V

Transverse vessels arranged—thick thin medium thin thick—or these are further intervened by parastigmatic vessels in some places. From 3 to 5 stigmata in each mesh, may be up to 9 in larger meshes along endostyle. Tentacles up to 19, larger and smaller ones differentiated; edge of dorsal lamina plain. Ciliated groove somewhat complicated. Second intestinal loop very shallow; when loop is deep enough, its axis passes through esophageal region. Stomach oval; plications rather distinct on attachment side (fig. 73*c*) while free surface is quite smooth, although about 7 folds seen faintly on inner wall. Anal margin cut into about 20 lobules. Gonads, 24 on left and 24–29 on right side in examined specimens, usually a single gonad in first intestinal loop. Gonads elongated; testicular follicles increase in number with size and are arranged roughtly in two rows on attachment side.

89. *Polycarpa melanosiphonica*, new species

FIGURE 74

HOLOTYPE.—USNM 11499: Gilbert Islands; Onotoa Atoll. A. H. Banner, sta. A XVI, August 24, 1951.

PARATYPE.—USNM 11508: Marianas Islands; lagoon west of Saipan, at entrance to Tanapag Harbor; attached to surface of a large dead coral, from ½-ton block brought up on anchor of L.T. 535, Capt. Ted Harris. P. E. Cloud, location 2, April 28, 1949.

DESCRIPTION.—A 17 mm. long specimen from the Gilbert Islands and a 14 mm. long individual from Saipan Island are described. Animal attached to substratum by posterior end or right ventral side of body. Branchial aperture terminal, atrial situated with its posterior margin at middle of body, both apertures nearly sessile. Test leathery, very tough, irregularly folded and strongly wrinkled over surface, attains 1 mm. thickness in some places; pale yellowish brown, areas around apertures somewhat whitish, each marked with four purplish-brown color bands converging to respective apertures, each band consists of several fine colored stripes. Inner surface somewhat paler with pearly glistening. Mantle yellowish white, moderately thick; both siphons short and darkly pigmented in purplish black (fig. 74*g*); viscera also yellowish white. Many elongated endocarps scattered over inner surface of mantle, larger ones faintly pigmented in purplish brown. Fine tentacles on atrial velum.

In branchial sac inner longitudinal vessels are arranged (D=dorsal, V=ventral):

Left	D	1	(10)	2	(10)	3	(10)	3	(8)	2	V
Right	D	1	(9)	3	(10)	3	(11)	1	(12)	2	V

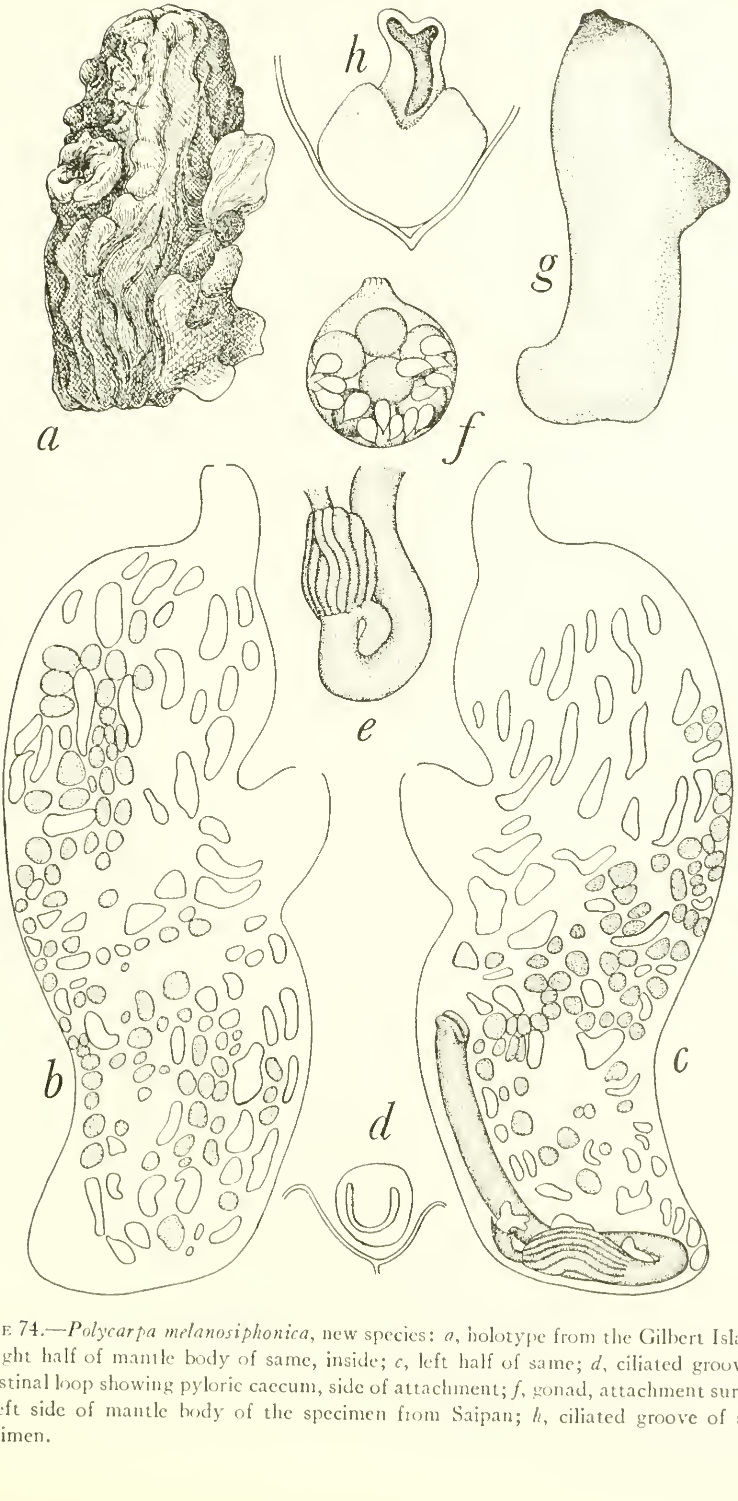

Figure 74.—*Polycarpa melanosiphonica*, new species: *a*, holotype from the Gilbert Islands; *b*, right half of mantle body of same, inside; *c*, left half of same; *d*, ciliated groove; *e*, intestinal loop showing pyloric caecum, side of attachment; *f*, gonad, attachment surface; *g*, left side of mantle body of the specimen from Saipan; *h*, ciliated groove of same specimen.

Transverse vessels arranged: thick thin medium thin thick; parastigmatic vessels nearly absent, only a few found sparsely in posterior part. Elongated stigmata 5 to 7 in each mesh. Tentacles 26–28, purplish black, larger and smaller ones differentiated. Ciliated groove U- or Y-shaped. Second intestinal loop practically indistinguishable. Stomach elongated with about 6 plications on each side and a very prominent pyloric caecum (fig. 74*e*). Rectum long, anal margin plain. Numerous small gonads spread over entire inner surface of mantle (figs. 74*b*, *c*, gonads shaded with dots, endocarps left blank). Gonads roundish in shape, much smaller than endocarps, about 0.5 mm. in diameter and each contain several eggs and very small testicular follicles up to about 15 in number, occupying peripheral part of attachment surface.

90. ***Polycarpa*** species

FIGURE 75

MATERIAL EXAMINED

PALAU ISLAND: Barrier reef 8 mi. NW. of Koror Island; GVF sta. 25. One specimen (USNM 11387).

DESCRIPTION.—A partly mutilated specimen from the Palau Islands was examined. Body elongated, attached to substratum by the ventral side and probably attains 24 mm. in length. Branchial aperture subterminal, atrial aperture nearly at middle of body. Middle part of animal, posteriorly including intestine and anteriorly covering ciliated groove, considerably mutilated. Test yellowish white, thin but very tough in consistency; inner surface whitish and partly with pearly glistening. Tips of siphons of mantle body reddish. Fine tentacles along the atrial velum. In branchial sac inner longitudinal vessels are (D=dorsal, V=ventral):

Left	D			——broken——					(16)	8	V
Right	D	7	(8)	11	(17)	8	(20)	10	(13)	9	V

Transverse vessels arranged: thick P thin P thick (P=parastigmatic vessel). Two or three stigmata in each mesh, may be up to six in meshes along endostyle. Tentacles at least 14, larger and smaller ones alternate regularly. Dorsal lamina a plain membrane. Only the oval

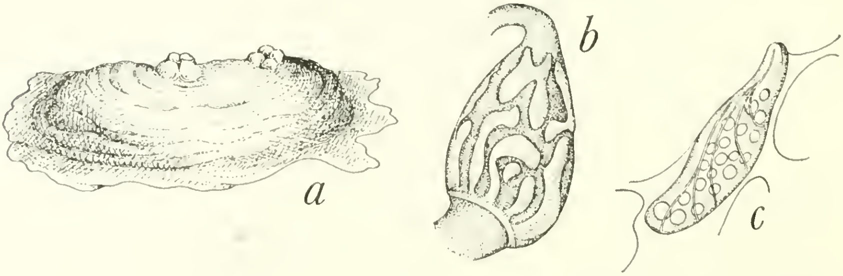

FIGURE 75.—*Polycarpa* species: *a*, The specimen; *b*, left side of stomach; *c*, gonad.

stomach uninjured; slightly narrowed towards cardiac end, about 16 longitudinal plications on surface, plications on attachment surface somewhat irregular. Polycarps 15 elliptical, about 1 mm. long, arranged mostly along endostyle(?), and found on inner surface of broken mantle.

91. *Cnemidocarpa areolata* (Heller)

FIGURE 76

Styela areolata Heller, 1878, p. 108, pl. 2, fig. 14.—Herdman, 1906, p. 316, pl. 4, figs. 24–33.—Van Name, 1918, p. 86, figs. 38–40; pl. 31, fig. 27.—Tokioka, 1950, p. 145, fig. 20.

Cnemidocarpa valborg Hartmeyer, 1919, p. 35, pl. 1, figs. 14–16.

Cnemidocarpa irma Hartmeyer & Michaelsen, 1928, p. 388, figs. 40–42.

Styela (*Cnemidocarpa*) *irma* Kott, 1952, p. 217, fig. 11.

Cnemidocarpa areolata Tokioka, 1953a, p. 254, pl. 54, figs. 1–9; pl. 68, figs. 5–8.—Tokioka 1953b, p. 14, fig. 9.—Tokioka, 1954a, p. 261, pl. 35, figs. 4–7.—Tokioka, 1954b, p. 85, fig. 3.—Tokioka, 1959a, p. 229, pl. 15, figs. 23–24.

MATERIAL EXAMINED

MARIANAS ISLAND: Saipan Island; Tanapag Harbor. P. E. Cloud, sta. D–7, One specimen (USNM 11501).

DESCRIPTION.—A 19 mm. long, rather elongated specimen from Saipan Island was examined. Animal attached to substratum by ventral side. Branchial aperture terminal, atrial situated fairly posterior to middle of body. Test very thin, leathery, and yellowish white, inner side whitish. Surface irregularly wrinkled by contraction. Mantle thin, light brownish. Musculature developed better than in small young individuals of *Polycarpa captiosa*, which resemble the present specimen very closely in general shape of mantle body. Rather stout atrial tentacles (fig. 76*e*) on velum. Endocarps on inner surface on both sides, several enclosed in first intestinal loop. In branchial sac inner longitudinal vessels are arranged (D=dorsal, V=ventral):

Left	D	0	(14)	3	(13)	3	(12)	3	(9)	3	V
Right	D	0	(13)	3	(13)	3	(12)	4	(10)	4	V

Transverse vessels arranged: thick r thin r medium r thin r thick, or, thick r thin r thick (r=parastigmatic vessel). Stigmata 3 to 5 in each mesh, may be up to 8 in meshes along endostyle. Tentacles 32; large, medium, and small ones differentiated. Ciliated groove simply U-shaped.

Axis of second intestinal loop passes through middle of oval stomach occupying about proximal one-third of ventral branch of first intestinal loop and having about 9 longitudinal plications on its free surface. Pyloric caecum not found, although inner pyloric corner of stomach is swollen insignificantly. Anal margin cut into 14 lobules. Two gonads on left and three on right side, all elongated. Testis situated on attachment surface, testicular follicles, up to about 25 in number, arranged roughly in two rows, though partly in a single row.

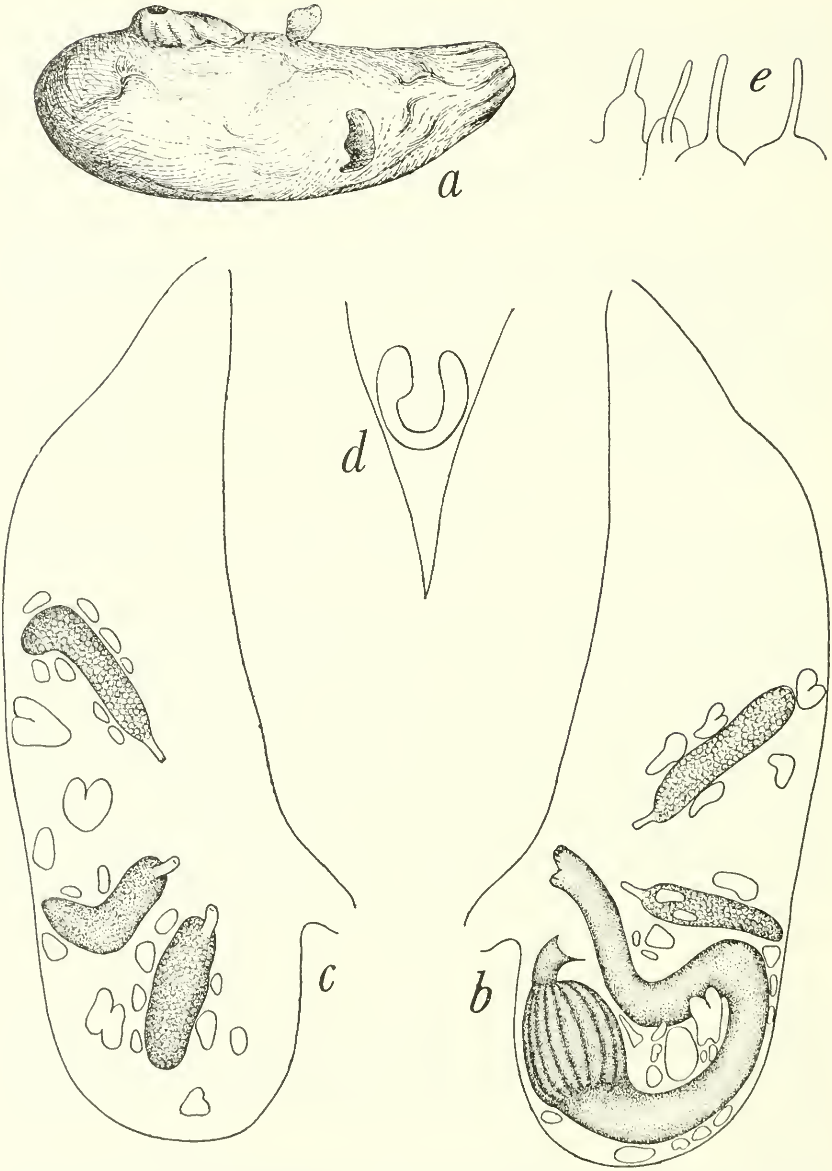

FIGURE 76.—*Cnemidocarpa areolata* (Heller); *a*, whole specimen; *b*, left half of mantle body, inner side; *c*, right half of same; *d*, ciliated groove; *e*, atrial tentacles.

REMARKS.—The elongated appearance of the present specimen, being much extended in the anterior half of the body, is unusual for *Cnemidocarpa areolata;* the gonads seem to be relatively fewer than usual. But without doubt this is a small individual of *C. areolata*, as the details of the internal structure conform exactly to those of the typical form of the species.

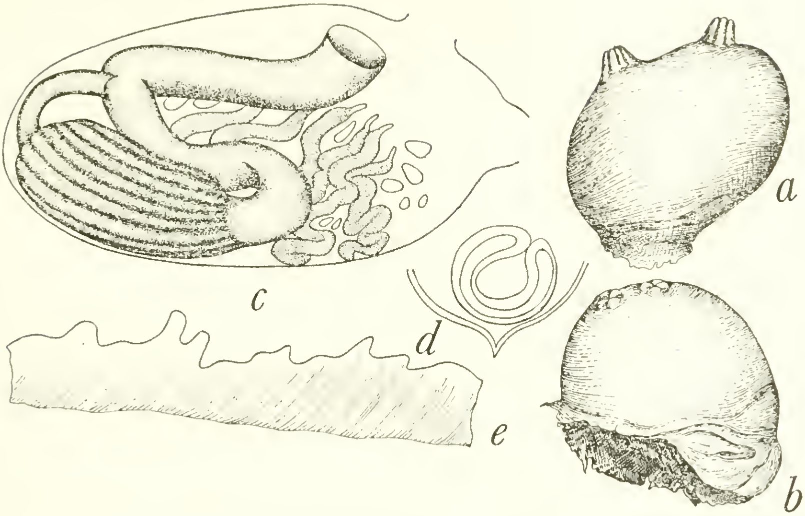

FIGURE 77.—*a*, *Cnemidocarpa fertilis* (Hartmeyer): entire animal. *b–e*, *Cnemidocarpa macrogastra* (Oka): *b*, entire specimen; *c*, left half of mantle body, inner side; *d*, ciliated groove; *e*, edge of dorsal lamina.

92. *Cnemidocarpa fertilis* (Hartmeyer)

FIGURE 77*a*

Styela fertilis Hartmeyer, 1906, p. 10.
Cnemidocarpa fertilis Tokioka, 1953a, p. 256, pl. 55, figs. 1–10; pl. 56, figs. 1–9; pl. 57, figs. 1–10.

MATERIAL EXAMINED

JAPAN: Honshu Island; off Manazuru Zaki, N. 8° W., 4.5 mi.; *Albatross* sta. 3698. Four specimens (USNM 11775).

DESCRIPTION.—Four specimens were found in the bottle in which *Herdmania momus* Savigny (cat. no. 11780) from Japanese waters were preserved. They are respectively 18, 21, 25, and 29 mm. in length, oval in shape, and attached to the substratum by the posterior left ventral side. Branchial aperture subterminal and anterior margin of short atrial siphon situated at middle of body. Test extremely thin, but considerably tough, grayish, with glistening silvery white; surface smooth. Gonads 6 on right (five in a group, one solitary) and 13 (divided into two groups consisting of 8 and 5 gonads) on left side in dissected 18 mm. long individual. Several copepods found in some specimens, many gymnothecous hydrozoan polyps attached on inner surface of branchial siphon in an examined specimen.

93. *Cnemidocarpa macrogastra* (Oka)

FIGURES 77*b–c*

Styela macrogastra Oka, 1935, p. 450, figs. 20–21.
Cnemidocarpa macrogastra Tokioka, 1953a, p. 260, fig. 18; pl. 59, figs. 1–7.—Tokioka, 1953b, p. 15.—Tokioka, 1953c, p. 27, fig. 1; pl. 1, fig. 1.—Tokioka, 1954b, p. 88.—Tokioka, 1959a, p. 231, pl. 16, fig. 25.

MATERIAL EXAMINED

Japan: Hokkaido Island; Otaru. E. S. Morse, coll. One specimen (USNM 11692).

Description.—A single 13 mm. tall specimen attached to the surface of a specimen of *Pyura mirabilis* Drasche collected in Japanese waters was examined. It is roughly hemispherical (fig. 77*b*) and attached to the substratum by the right ventral side. Both apertures sessile. Test extremely thin, but tough, pale brownish white, surface quite smooth. On mantle body branchial aperture nearly terminal, atrial subterminal. Mantle thin but strong, brownish orange, color deepest on siphons. Atrial tentacles found on velum. Tentacles about 17(?), edge of dorsal lamina irregularly serrated (fig. 77*e*). Ciliated groove simply U-shaped. Six slender gonads on each side. About 30 testicular follicles found on a 4.5 mm. long undulating gonad, arranged roughly in a single row on attachment surface.

94. ***Cnemidocarpa personata*** **(Herdman)**

Figure 78

Styela personata Herdman, 1899, p. 41, pl. Cyn. 15, figs. 1–7.
Styela etheridgii typical "*personata*" form, Kott, 1952, p. 220, figs. 19–20.

MATERIAL EXAMINED

Australia: Port Jackson. William Stimpson, North Pacific Exploring Exped., 1853–56, sta. SH 142. Two specimens (USNM 11758), on *Herdmania momus* f. *grandis* (Heller) (USNM 11767).

Description.—The two specimens examined were found attached to a giant specimen of *Herdmania momus* f. *grandis* (USNM 11767) from Northern Australia. Specimens measured 22 mm. and 28 mm. in length, were attached by right ventral side in the smaller, and by whole ventral side in the larger specimen. Test leathery but thin, yellowish brown, irregularly grooved on surface. Branchial aperture subterminal, atrial aperture situated with anterior margin located at or near middle of body; both apertures nearly sessile as siphons are extremely short. Inner surface of test whitish. Mantle of a moderate thickness, yellowish brown. Numerous endocarps on inner surface, fine atrial tentacles along the inner base of atrial siphon.

In branchial sac inner longitudinal vessels in the 22 mm. long specimen arranged (D=dorsal, V=ventral):

Left	D	0	(33)	3	(20)	7	(21)	7	(16)	5	V
Right	D	6	(20)	5	(20)	6	(18)	6	(15)	3	V

Transverse vessels arranged: thick thin thin thin medium thin thin thin thick. Parastigmatic vessels present; 3 to 5 stigmata in each mesh. Tentacles about 30, large and small alternate regularly. Ciliated groove U-shaped, with one arm incurled. A parasitic copepod found in branchial sac of one specimen.

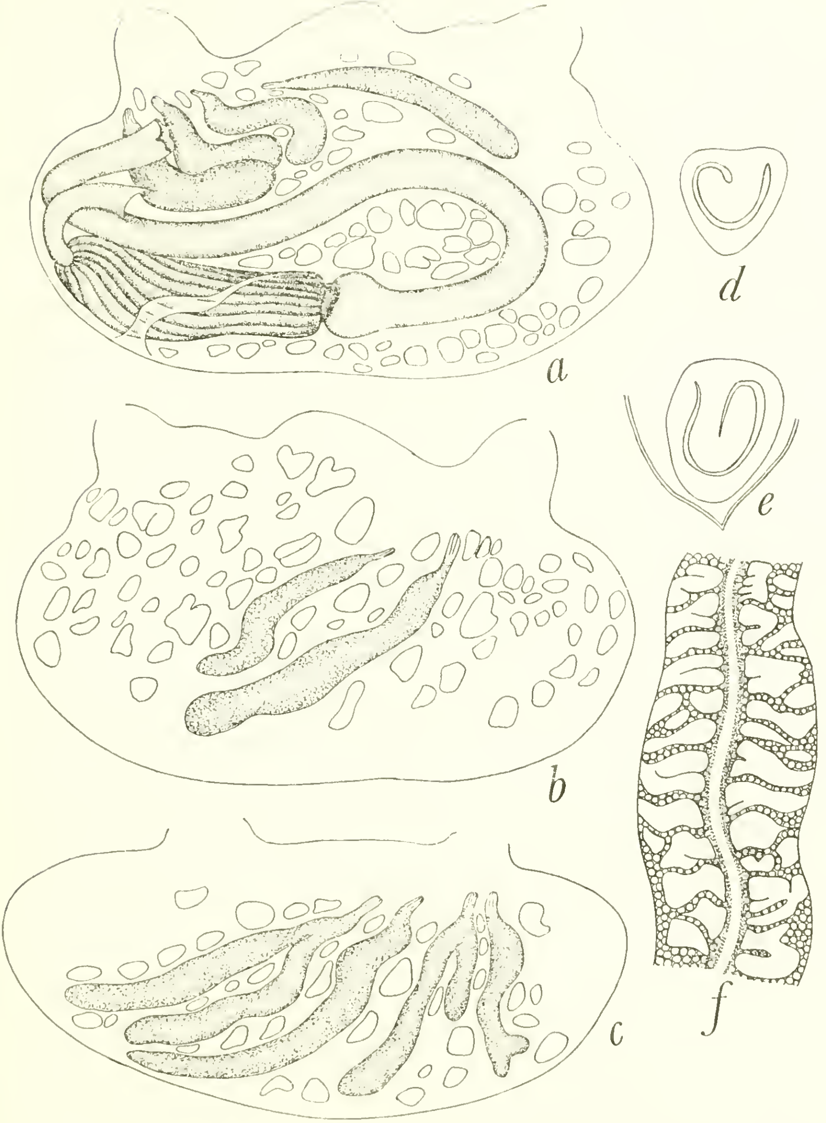

FIGURE 78.—*Cnemidocarpa personata* (Herdman): *a*, left half of mantle body of 22 mm. specimen, inner side; *b*, right half of same; *c*, right half of mantle body of 28 mm. specimen, inner side; *d*, *e*, ciliated grooves; *f*, attachment surface of part of gonad, showing arrangement of testicular follicles.

Intestinal loop comparatively large, occupying nearly entire ventral half of left side of mantle body. Axis of second intestinal loop passes through esophageal region. Stomach elongated, slightly longer than half of ventral branch of first intestinal loop, with about 20 longitudinal plications on surface. Inner pyloric corner insignificantly swollen, but no caecum formed there. Anal margin undulating, forming several lobes, or divided into about 20 lobules. Two to four elongate gonads on both right and left sides; some branched (fig. 78*c*). Testicular follicles very numerous, arranged roughly in two rows on attachment surface of gonad; follicles somewhat irregular in shape when fully matured, and may extend to and cover lateral side of gonad.

Remarks.—The internal structure of these two specimens very closely resembles that of *Cnemidocarpa macrogastra* known from Japanese waters. However, the relative size of the stomach is somewhat smaller in the present specimens than in *C. macrogastra*. Moreover, the distance between the apertures is much larger in the former than in the latter.

95. *Cnemidocarpa incubita* (Sluiter)

Figures 79, 80

Styela incubita Sluiter, 1904, p. 75, pl. 2, fig. 7; pl. 9, figs. 11–14.

MATERIAL EXAMINED

Marianas Islands: Saipan Island; lagoon, Tanapag Harbor. P. E. Cloud, sta. D–7. One specimen (USNM 11500).

Description.—A 9 mm. specimen from Saipan Island was examined. Animal densely encrusted with white coarse sand grains except ventral side, by which it attaches to substratum, test very thin here. Branchial aperture subterminal, atrial aperture well apart from branchial; both apertures sessile, 4-lobed. Test translucent, tough, milky white. Mantle extremely thin, adheres firmly to test. On mantle body anterior margin of atrial aperture situated at middle of body. Very fine tentacles along atrial velum. Endocarps present on inner surface of mantle.

In branchial sac inner longitudinal vessels arranged (D=dorsal, V=ventral):

Left	D	1	(11)	1	(7)	1	(9)	2	(7)	1	V
Right	D	0	(10)	1	(9)	1	(9)	1	(8)	1	V

Transverse vessels nearly of same thickness, parastigmatic vessels found at some parts of sac. Stigmata 5 to 7 elongated in each mesh, may be up to 9 in those along endostyle. Tentacles about 25, larger and smaller ones differentiated. Ciliated groove a longitudinal slit, margin dotted with pigment spots. First intestinal loop very elongated, anterior end reaches slightly beyond middle of body. Axis of second intestinal loop passes through cardiac end of stomach, which is elongated and occupies approximately one-half of ventral branch of first intestinal loop. Plications on stomach surface 17; a remarkably large caecum found at inner pyloric corner, tip strongly curved towards ventral side, whole caecum connected to various parts of intestinal loop by several haemal vessels (fig. 79*d*). Esophagus very short. Anal margin thickened, forming 8 distinct lobules. On left 8 elliptical gonads, and 10 on right side. Testis occupies attachment surface of

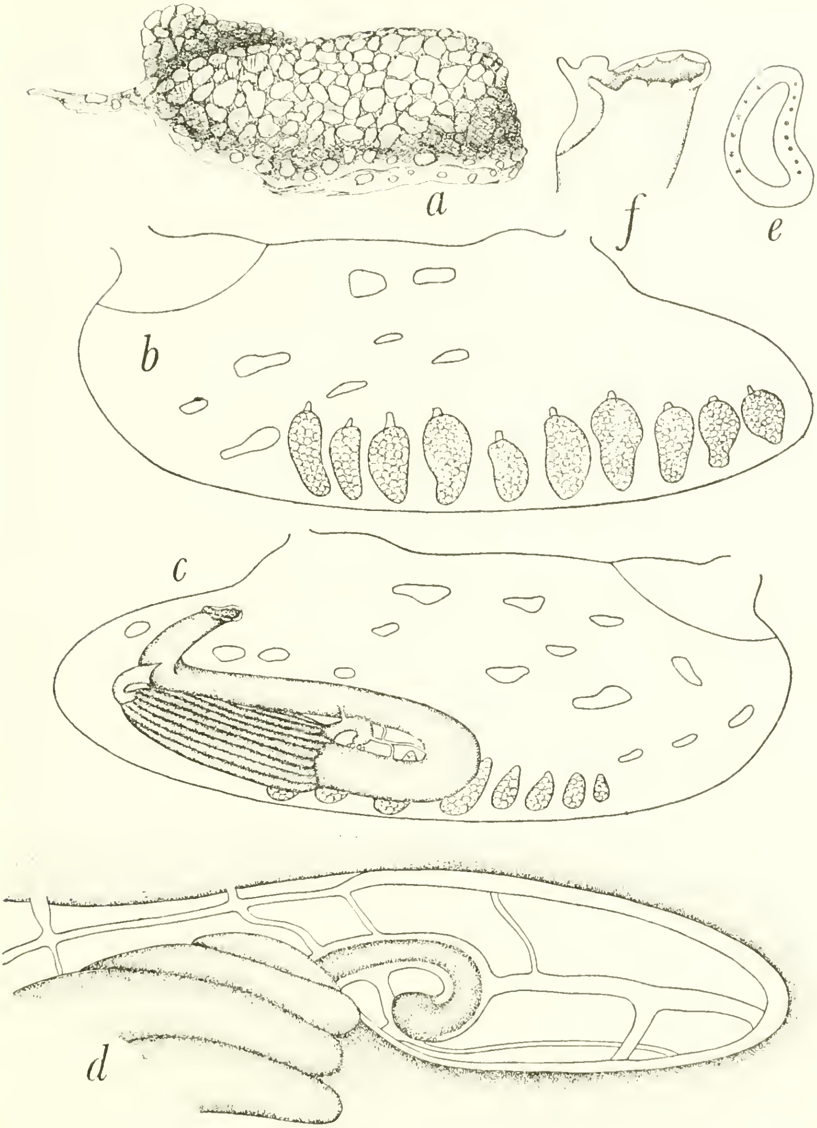

FIGURE 79.—*Cnemidocarpa incubita* (Sluiter): *a*, specimen from Saipan Island; *b*, right half of mantle body, inner side; *c*, left half of same; *d*, first intestinal loop; *e*, ciliated groove; *f*, anus.

gonad, consists of a single, or two unequally divided lobules (figs. 80*a–c*).

REMARKS.—Sluiter's original specimen of *Styela incubita* is 12 mm. long, the ventral side is covered with segments of *Halimeda*, while the dorsal side is exposed. No descriptions are given of the pyloric caecum. Gonads are all roundish in shape. Some of these features

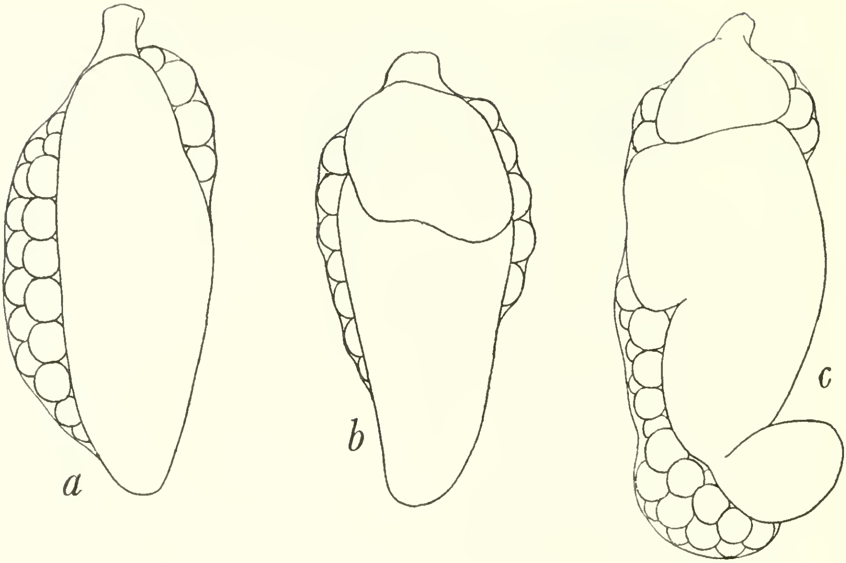

FIGURE 80.—*Cnemidocarpa incubita* (Sluiter): Three gonads from attachment surface.

seem to differ somewhat from those of the present specimen from Saipan Island, but it is very probable that such differences are specifically quite insignificant. As the general features of the inner structure is quite similar in these two specimens, the present individual may safely be identified as *S. incubita.*

96. *Cnemidocarpa chinensis,* new species

FIGURE 81

HOLOTYPE.—USNM 11799: China; probably Amoy, received May 20, 1924, from S. F. Light.

PARATYPES.—USNM 11800: same data. 9 specimens.

DESCRIPTION.—Examined were the 10 specimens from China, all are roughly bean-shaped in outline, from 12 mm. to 18 mm. in length and 8–9 mm. in width, with their whole left side beneath. They are considerably flattened laterally so that the thickness of animals is only 3–4 mm. As two of the specimens were found attached to each other side by side, they are possibly crowded in their natural habitat. Branchial aperture subterminal and atrial aperture located very near branchial, both apertures nearly sessile. Test very hard, about 1 mm. in thickness, being densely encrusted and impregnated with fine sand grains. Issuing from periphery of body except siphonal region are 10–20 tufts of short but rather thick rootlets. Mantle yellowish white, of moderate thickness. Many small endocarps on inner surface, very prominent tentacles along inner base of atrial siphon.

In branchial sac inner longitudinal vessels arranged (D=dorsal, V=ventral):

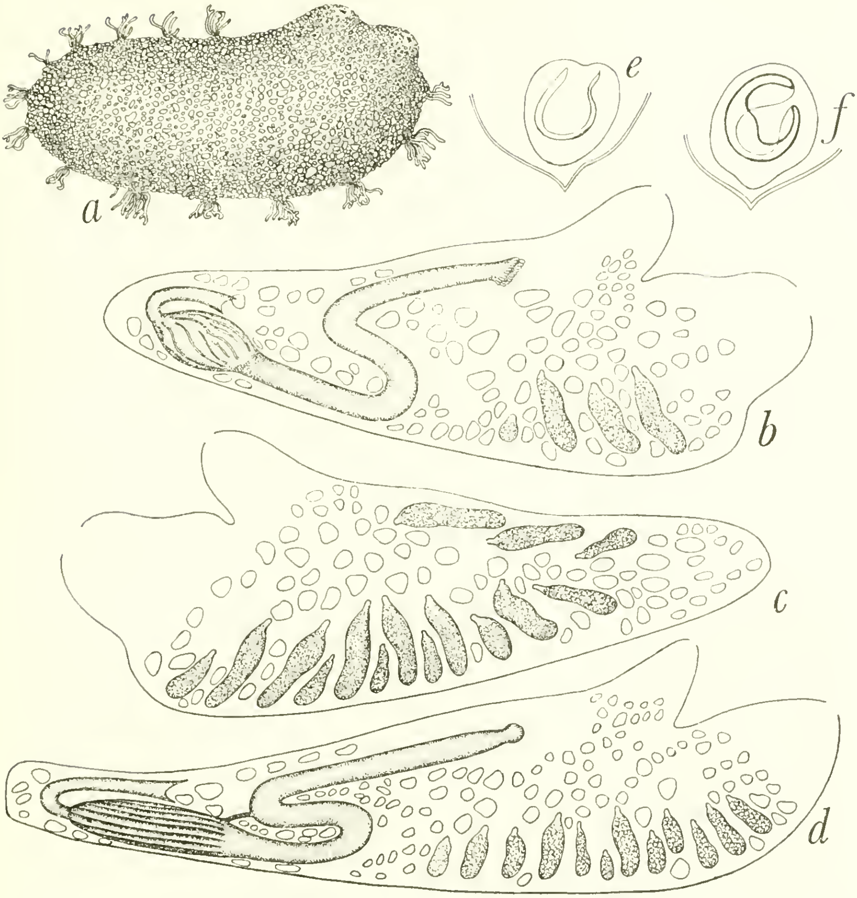

FIGURE 81.—*Cnemidocarpa chinensis,* new species: *a,* right side of an individual; *b,* left half of mantle body, inner side; *c,* right half of same; *d,* left half of mantle body of a larger individual, inner side; *e, f,* ciliated grooves.

Left	D	0	(10)	1	(4)	2	(6)	2	(5)	2	V
Right	D	1	(6)	1	(6)	2	(8)	2	(5)	2	V

Left second fold seems to be smaller than others also in other specimens. Transverse vessels alternate with parastigmatic vessels. Four to six elongated stigmata in each mesh. Tentacles 30–40; ciliated groove U-shaped. Entire alimentary canal S-shaped, located in somewhat narrowed posterior part of body; rectum very long. Second intestinal loop very prominent; its axis passes obliquely through middle of stomach, which varies in shape rather individually; it occupies one-third to one-half of ventral branch of first intestinal loop. Surface of stomach longitudinally plicated, about 8 plications counted on free surface in an examined specimen; pyloric caecum absent, although a thin vessel connects inner pyloric corner of stomach and bottom part of second intestinal loop in some specimens. Anal margin cut in finely. Gonads 4–12 on left and 15–27 on right side, somewhat elongated. Testicular follicles up to about 15, arranged in two rows on attachment surface.

97. *Styela plicata* (Lesueur)

Ascidia plicata Lesueur, 1823, p. 5, pl. 3, fig. b.

MATERIAL EXAMINED

China or Japan: From the bottom of the USS *Palos* after a voyage across the Pacific from China or Japan. P. L. Jouy, no. 2479. Fifteen specimens (USNM 11711).

Description.—The largest of the 15 specimens examined is 61 mm. in length, and has 2 gonads on the left, and 5 on the right side. Test leathery, thin but tough, yellowish white; mantle brownish.

98. *Styela clava* Herdman

Figure 82

Styela clava Tokioka, 1959b, p. 462 (references).

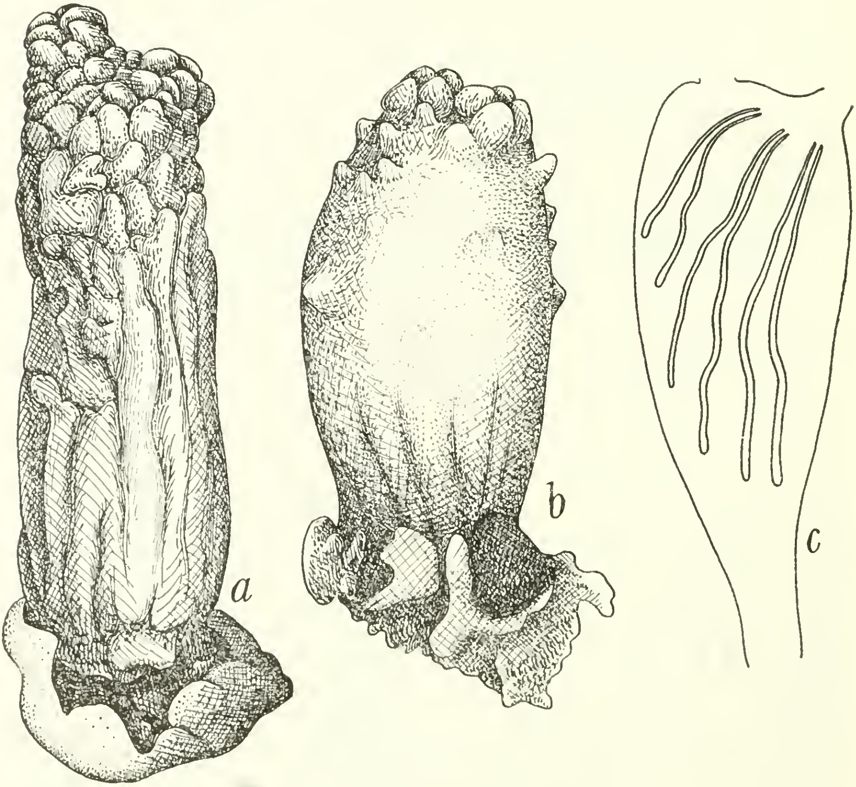

Figure 82.—*Styela clava* Herdman: *a*, 25 mm. specimen from Chefoo; *b*, 16 mm. specimen from same locality; *c*, right half of mantle body of Japanese specimen, inner side.

MATERIAL EXAMINED

CHINA: Chefoo. C. Ping, sta. 21. Three specimens (USNM 11763).—Shanghai. A. de C. Sowerby, sta. 827, early summer 1924. One specimen (USNM 11710).

JAPAN: Honshu; Wakaura, Kii. E. S. Morse, coll. One specimen (USNM 11700).—Honshu; Kobe. Seven specimens (USNM 11703).—Honshu; Samé, Mutsu. *Albatross*, 1906. One specimen (USNM 11742).—Kyushu; Nagasaki. Four specimens (USNM 11708).

DESCRIPTION.—Specimens examined were 13 from Japanese waters and 4 small ones from the Chinese coast. Most Japanese specimens pedunculated, largest 65 mm. in body length, with a stalk 50 mm. long. Chinese specimens all less than 25 mm. in length, erect, attached to substratum by posterior end, without any stalk (figs. 82*a*,*b*). Descending branch of intestinal loop longer than half of ascending branch, except in a 16 mm. long specimen from China, in which descending branch is only approximately half of ascending branch. In specimen from northern district of Japan (USNM 11742) body length 20 mm., stalk 27 mm. long, 6 gonads arranged in three pairs (fig. 82*c*) on right side. Of Chinese specimens, the 16 mm. long individual has 8 matured gonads on the right, 3 matured and 1 rudimentary gonad on left side.

99. *Styela atlantica* (Van Name)

FIGURE 83

Tethyum atlanticum Van Name, 1912, p. 552, fig. 31; pl. 59, figs. 92–93; pl. 60, fig. 96; pl. 68, fig. 135.

Styela (*Botryorchis*) *atlantica* Van Name, 1921, p. 440, fig. 106.

Styela atlantica Huus, 1936, p. 1, figs. 1–8.—Van Name, 1945, p. 293, figs. 179G and 189–191; pl. 8, fig. 3.—Tokioka, 1953a, p. 264, pl. 61, figs. 1–4; pl. 62, figs. 1–4.

MATERIAL EXAMINED

JAPAN: Honshu Island; off Manazuru Zaki N. 8° W., 4.5 mi.; *Albatross* sta. 3698. Nine specimens (USNM 11747), together with *Herdmania momus* (Savigny).

DESCRIPTION.—There are nine specimens in the material. Two of them, roughly oval in shape (fig. 83*a*) and 15 mm. and 18 mm. in length, were found among the specimens of the deep-water form of *Herdmania momus* (Savigny), collected from Japanese waters. Surface nearly smooth, carries sand grains sparsely on basal half, some fine rooty hairs issue from basal part; apertures inconspicuous, each opens on a small prominence at distal end of body. External appearance resembles closely that of *Cnemidocarpa fertilis molguloides*. In the 15 mm. long specimen (fig. 83*b*), posterior end of body unusually prolonged into a long thin peduncle, 18 mm. in length. Other seven specimens were attached to surface of above-mentioned pyurid specimens by ventral side, considerably flattened dorsoventrally (fig. 83*c*), 5 to 15 mm. in length and up to 10 mm. in height. Surface finely wrinkled, holding mud, and fine rooty hairs issue along periphery of basal attachment surface. Both apertures are 4-lobed and open on

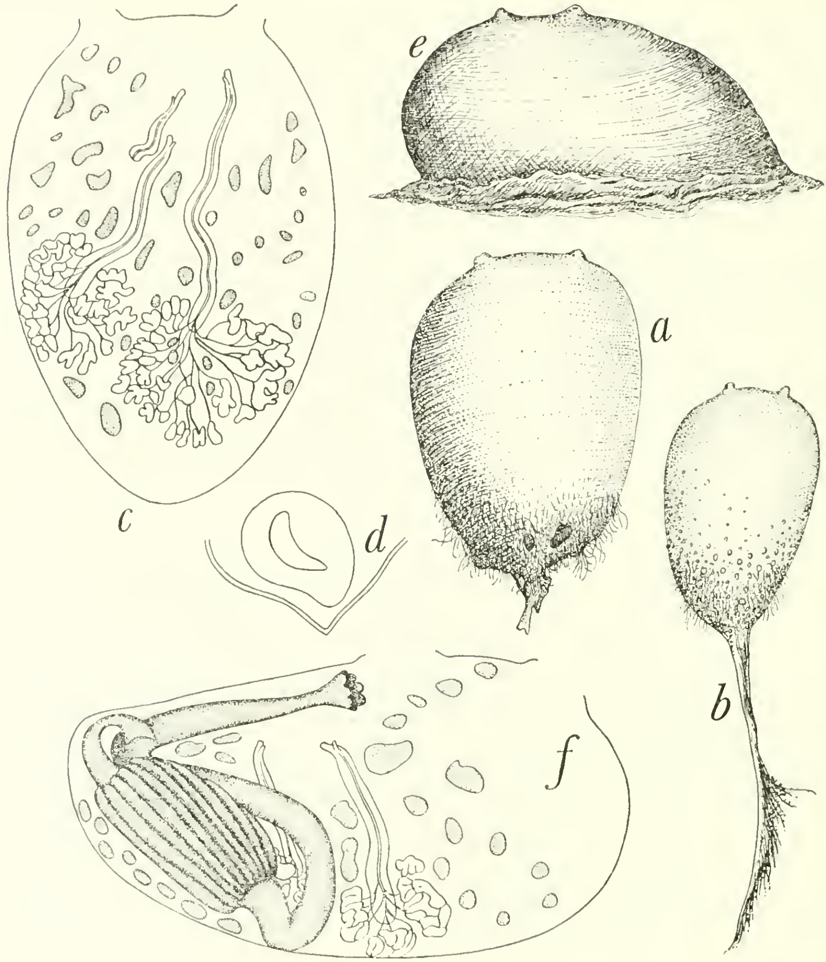

FIGURE 83.—*Styela atlantica* (Van Name): *a*, the 18 mm. oval individual; *b*, the 15 mm. individual with unusual peduncular prolongation; *c*, right half of mantle body of same specimen, inner side; *d*, ciliated groove of a 13 mm., somewhat flattened, specimen; *e*, entire appearance of same specimen; *f*, left half of mantle body of same specimen, inner side.

small prominences, being apart from each other by about one-third of body length. Test very thin, encrusted and impregnated with mud. Inner surface whitish and glistening . Mantle thin, yellowish brown. Atrial tentacles present.

A 13 mm. long individual was dissected to make identification of these flattened specimens certain. Inner longitudinal vessels of the branchial sac are arranged (D=dorsal, V=ventral):

Left	D	2	(11)	5	(14)	4	(17)	5	(11)	2	V
Right	D	4	(22)	4	(12)	4	(16)	5	(9)	2	V

One thicker and three thinner transverse vessels alternate regularly; a parastigmatic vessel intervenes in every interval. Stigmata 3 to 5 in each mesh, up to 8 in larger meshes along endostyle. Tentacles 27, larger and smaller ones differentiated. Ciliated groove simple. Second intestinal loop distinct, axis passes through cardiac end of elliptical stomach, which is completely liberated from body wall and has 25 longitudinal plications on surface and a distinct pyloric caecum. Anal margin cut into about 15 lobules. Two gonads on each side, testicular follicles confined to area surrounding ventral end of gonad. In the 15 mm. long individual with an unusual peduncular prolongation of the test, an excess short third gonad was found on right side (fig. 83*e*).

REMARKS.—It is evident that the specimens here treated are *S. atlantica*, although they show rather unusual shape or appearance. The remarkable decrease of test thickness seems to occur in deep-water forms of various ascidians.

100. *Styela izuana* (Oka)

Molstyela izuana Oka, 1934, p. 292, figs. A–C.
Styela izuana Tokioka, 1953a, p. 269, pl. 64, figs. 1–5.

Styela izuana hawaiiensis, new subspecies

FIGURE 84

HOLOTYPE.—USNM 11794: Hawaiian Islands; south coast of Oahu, off Diamond Head Light N. 21° E., 6.9 miles; 304–308 fathoms, fine white sand, mud. *Albatross* sta. 3908, May 5, 1902.

PARATYPES.—USNM 11795: Hawaiian Islands; northeast approach to Pailolo Channel between Maui and Molokai; off Mokuhooniki Islet S. 61° W., 10.6 miles; 290–286 fathoms, brown mud, fine sand, *Globigerina*. *Albatross* sta. 4095, July 22, 1902. Nine specimens.

DESCRIPTION.—Ten specimens from Hawaiian waters were examined, the largest (holotype) is 16 mm. in length. All are ellipsoidal in shape with hairy processes all over surface, leaving narrow dorsal siphonal area exposed. Hairy processes usually hold some mud or fine sand grains, siphonal area encrusted with fine sand grains. Test thin, rather soft and translucent. Both apertures 4-lobed, sessile and separated from each other by about 5 mm. Mantle thin, pale brownish orange on dorsal, but yellowish on ventral side. Fine tentacles along margin of atrial velum.

Inner longitudinal vessels of branchial sac arranged in 16 mm. long individual (D=dorsal, V=ventral):

Left	D	11	(20)	3	(14)	5	(21)	8	(8)	6	V
Right	D	0	(18)	4	(14)	3	(25)	7	(14)	7	V

Transverse vessels arranged: thick r thin r thick, or, thick r thin r thin r thin r thick (r=parastigmatic vessel). Two to four elongated stig-

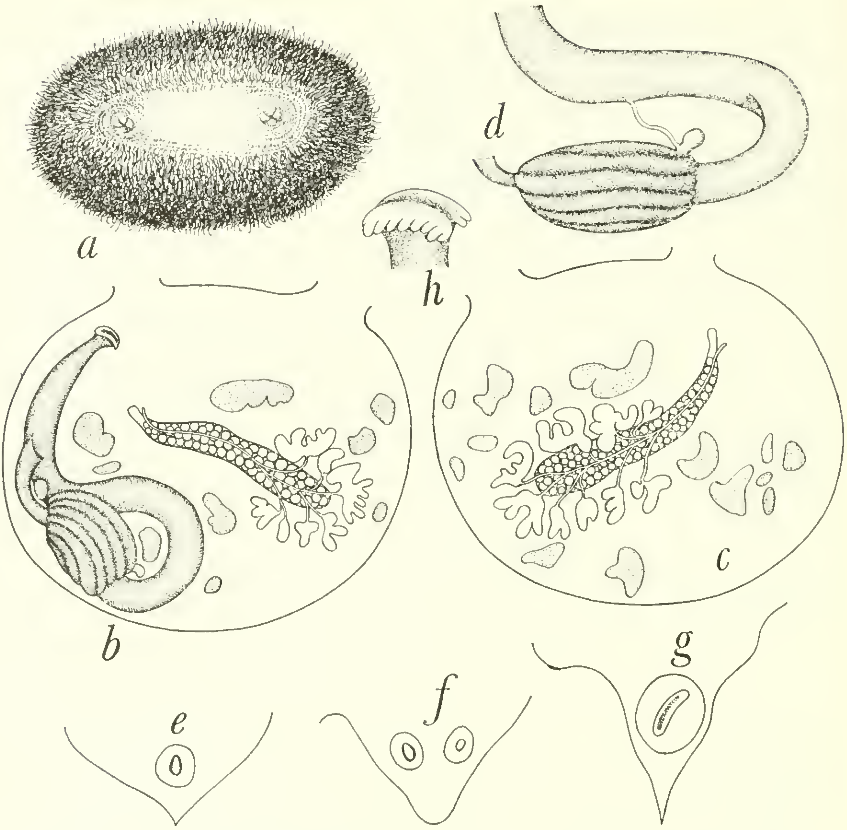

Figure 84.—*Styela izuana hawaiiensis*, new subspecies: *a*, dorsal side of 16 mm. individual; *b*, left half of mantle body, inner side; *c*, right half of same; *d*, intestinal loop; *e–g*, ciliated grooves; *h*, anus.

mata in each mesh, may be up to nine in those along endostyle. Tentacles about 20, excluding minute ones. Ciliated groove an elongated slit or small oval opening, represented in a specimen by two orifices (fig. 84*f*). Alimentary canal rather small, occupying posteroventral one-third of left side. Second intestinal loop shallow, with axis passing through cardiac portion of stomach, which is elongated in extended state and has about 15 longitudinal plications on surface and distinct pyloric caecum. Stomach larger than half of ventral branch of first intestinal loop. Esophagus not so long. Anal margin cut into 20–25 lobules. A single elongated gonad on each side. Testicular follicles confined to area around posterior half or posterior end of gonad.

Remarks.—The present specimens resemble very closely *Styela izuana* (Oka), 1934, from Japanese waters in the general appearance of the body and in the number of the gonads, but differ from the latter in the following points: (1) The alimentary canal is larger in *S.*

izuana, occupying the whole ventral half of the left side, it is confined to the posteroventral part of the left side in the present specimens; (2) the stomach has many more, up to 40, longitudinal plications, but without any distinct pyloric caecum in *S. izuana;* (3) the lobation of the anal margin is more remarkable in the present specimens than in *S. izuana*, in which only four lobes are defined; (4) testicular follicles are found along nearly the whole lateral sides of the gonad in *S. izuana;* (5) the ciliated groove is U-shaped in *S. izuana*. At present, however, it seems that these differences cannot be accepted as being of the specific importance to separate these specimens from *S. izuana*. Rather, I prefer to treat the present specimens as a subspecies of *S. izuana*.

101. *Styela coriacea* (Alder & Hancock)

FIGURE 85

Cynthia coriacea Alder & Hancock, 1848, p. 195.

Styela coriacea Hartmeyer, 1923, p. 220 (synonymy).—Van Name, 1945, p. 285, figs. 179F, 181–183 (synonymy).

Styela plata Oka, 1930, p. 427, figs. A–C.

MATERIALS EXAMINED

JAPAN: Hokkaido Island; Otaru. E. S. Morse, coll. Specimens, 27 (USNM 11688).

DESCRIPTION.—Examined were 27 specimens from Hokkaido Island, Japan. All are low, conical in shape, with a very wide membranous marginal prolongation of test around base of animal, and attached to the substratum by whole wide underside. Largest of the specimens is 25 mm. × 21 mm. in extent and 7–9 mm. in height. Branchial aperture subterminal and atrial situated near it, both apertures 4-lobed and nearly sessile. Test thin, leathery and pale yellowish; basal marginal portion of test densely encrusted with fine black sand grains which gradually decrease density towards animal body proper. Thus dorsal siphonal region always exposed. Surface wrinkled irregularly by contraction. Mantle delicate, especially in ventral half; yellowish brown.

Inner longitudinal vessels of branchial sac arranged (D=dorsal, V=ventral):

Left	D	0	(10)	2	(5)	2	(10)	2	(8)	1	V
Right	D	0	(11)	2	(7)	1	(10)	2	(8)	1	V

Transverse vessels and parastigmatic vessels alternate regularly; sometimes thinner parastigmatic vessels of second order may be found in intervals between transverse vessels and usual parastigmatic vessels of first order. In each mesh 7 to 10 very elongated stigmata, may be up to 20 in larger meshes along endostyle. Tentacles 25–30; edge of dorsal lamina plain. Axis of second intestinal loop passes through esophageal region. Stomach elongated, longer than half of ventral

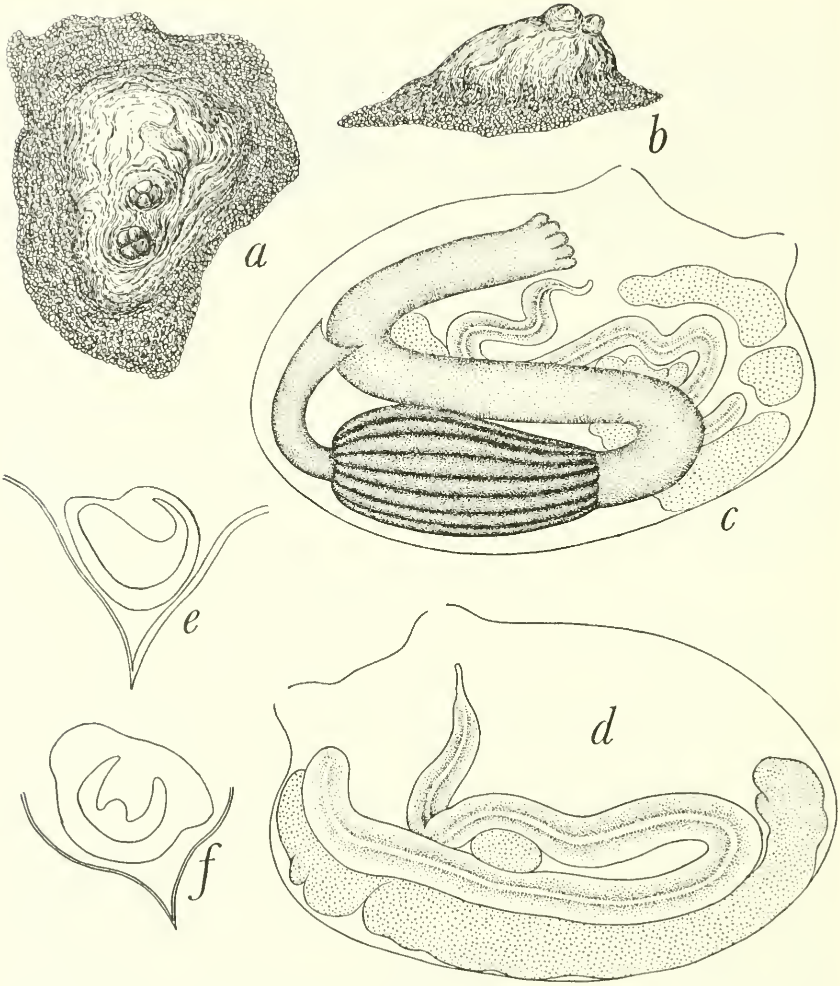

FIGURE 85.—*Styela coriacea* (Alder & Hancock) *a*, 25 mm. specimen, dorsal side; *b*, lateral side of same specimen; *c*, left half of mantle body, inner side; *d*, right half of same; *e*, *f*, ciliated grooves.

branch of first intestinal loop, and with about 8 longitudinal plications on each side. Anal margin cut into about 10 very distinct lobules. A single gonad on each side, consisting of a long strongly curved ovary and some large testicular masses located mostly around posterior part of ovary on left side, but along ventral side of posterior half of ovary on right side. These masses variously lobated on each side; also a few small masses may be found in other parts of gonad.

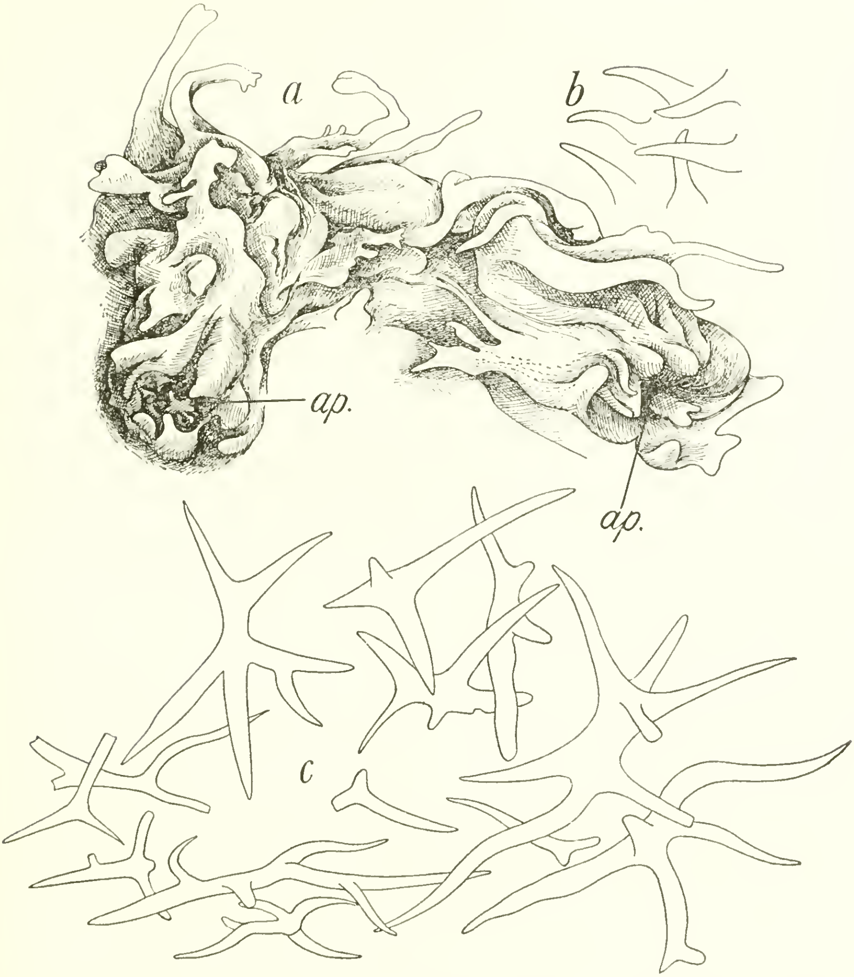

FIGURE 86.—*Pyura sacciformis* (von Drasche): *a*, dorsal ridge between the apertures (ap.), 25 mm. specimen; *b*, minute finger-shaped protuberances on inner surface of mantle; *c*, spicules from the tentacles.

Family Pyuridae

102. *Pyura sacciformis* (von Drasche)

FIGURE 86

Cynthia sacciformis von Drasche, 1884, p. 376, pl. 5, figs. 2-3.
Cynthia sanderi Traustedt & Weltner, 1894, p. 11, pl. 2, figs. 1-3.
Halocynthia sanderi Hartmeyer, 1906, p. 5.
Pyura aspera Tokioka, 1949a, p. 10, pl. 4, figs. 6-8.
Pyura masuii Tokioka, 1949b, p. 57, fig. 12.
Pyura sanderi Tokioka, 1953a, p. 275, pl. 67, figs. 1-9; pl. 68, figs. 1-2.

MATERIAL EXAMINED

JAPAN: Honshu Island; off Suno Saki N. 89° E., 8.75 mi.; *Albatross* sta. 3745, One specimen 45 mm. in length (USNM 11771).—Kyushu Island; Nagasaki; E. S. Morse, coll. One specimen 25 mm. in length (USNM 11701).

DESCRIPTION.—Two specimens from Japanese waters were examined, one 25 mm., the other 45 mm. in length. Mantle body of smaller specimen quite mutilated; however dorsal ridge connecting both apertures, characteristic for present species, is preserved perfectly. It is 19 mm. long, furnished with many irregularly formed protuberances. In larger specimen dorsal ridge made rather obsolete by finger-shaped protuberances on test surface, also by contraction of animal. Test cartilaginous, yellowish white, attains 4 mm. thickness in some places. Inner surface of mantle and surface of alimentary organs and gonads covered with minute finger-shaped protuberances, larger on inner surface of mantle than on surface of other organs. Also many complicatedly horn-shaped spinules embedded in inner surface layer of mantle, gonads, intestine, ciliated groove, tentacles and most abundantly in larger vessels of branchial sac. They are glistening brownish gold; vary considerably in size, medium-sized, usually 250–300μ in length. Six folds on each side of branchial sac; inner longitudinal vessels arranged (D=dorsal, V=ventral):

Left	D	4	(23)	2	(26)	3	(26)	4	(23)	3	(21)	4	(15)	5	V
Right	D	5	(24)	2	(27)	3	(28)	4	(23)	4	(21)	4	(20)	7	V

Transverse vessels arranged: thick thin medium thin thick, every interval being intervened by parastigmatic vessels. Very delicate secondary parastigmatic vessels may be found in some places. About 10 elongated stigmata in each mesh. Right gonad consists of 20 genital capsules, in left only 6 capsules in the 45 mm. long specimen.

103. *Pyura lepidoderma* Tokioka

FIGURE 87

Pyura lepidoderma Tokioka, 1949a, p. 10, pl. 5, figs. 1–3.—Tokioka, 1953b, p. 19, fig. 12.—Tokioka, 1953c, p. 28, pl. 1, fig. 2.—Tokioka, 1954b, p. 91, fig. 5.—Tokioka, 1959a, p. 231.

MATERIAL EXAMINED

JAPAN: Honshu Island; off Ose Zaki, S. 81° W., 4.2 mi.; *Albatross* sta. 3713. One specimen 12 mm. long (USNM 11731).

DESCRIPTION.—A single specimen 12 mm. long dredged from 65 fathoms in Japanese waters was examined. Branchial and atrial apertures each surrounded by four small plates. Six folds on each side of the branchial sac. Right gonad consists of 15 genital capsules, the left gonad 16 capsules. Anal margin plain.

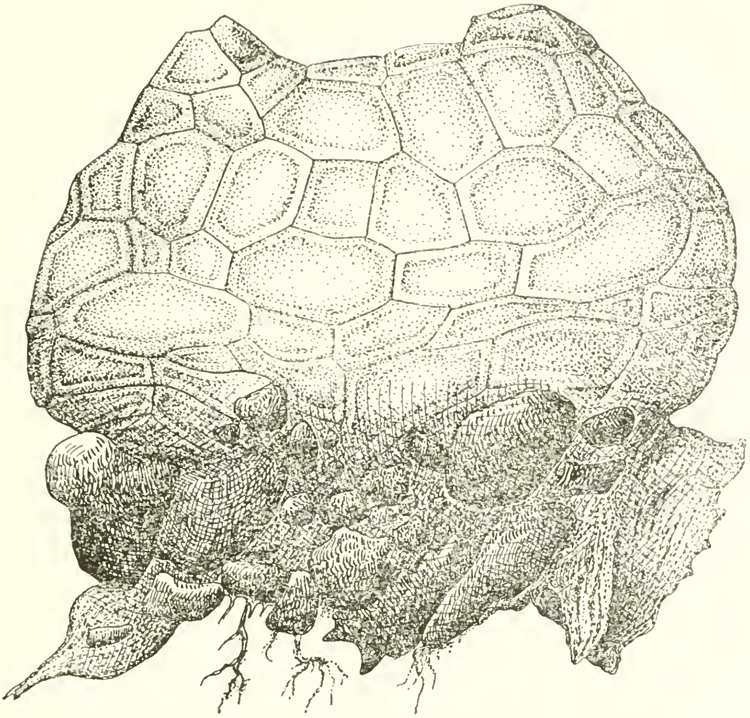

FIGURE 87.—*Pyura lepidoderma* Tokioka: The 12 mm. specimen from Japan.

104. *Pyura curvigona* Tokioka

FIGURES 88, 89

Pyura curvigona Tokioka, 1950, p. 147, fig. 22; pl. 10, figs. 4–6.

MATERIAL EXAMINED

PALAU ISLANDS: Iwayama Bay; south end of Guazima (Island XV). GVF sta. 92. Two specimens (USNM 11409).—Iwayama Bay; south end of Island XX. GVF sta. 134. One specimen (USNM 11405) attached to *Turbinaria*.

DESCRIPTION.—Three specimens from the Palau Islands were examined, 30 mm., 26 mm., and 5 mm. in length; the last with a 9 mm. long extension of the test from the posterior end of the body (fig. 89*a*). Animals attached to substratum by right or left ventral side or by anterior right side of body. Branchial aperture subterminal, atrial aperture situated near middle of body. Apertures nearly sessile or opened on low elevations. Test leathery, yellowish white, milky white with reddish tint, or dark brownish on dorsal side, but pale on the ventral half. Specimen from sta. 134 was yellowish green when alive. Test thin, though slightly thicker on dorsal side, but very tough. Inner side nearly of same color as outer surface, but somewhat lighter with white pearly glistening. Neighborhood of apertures corrugated or formed into a number of small lobes, carries a small amount of mud

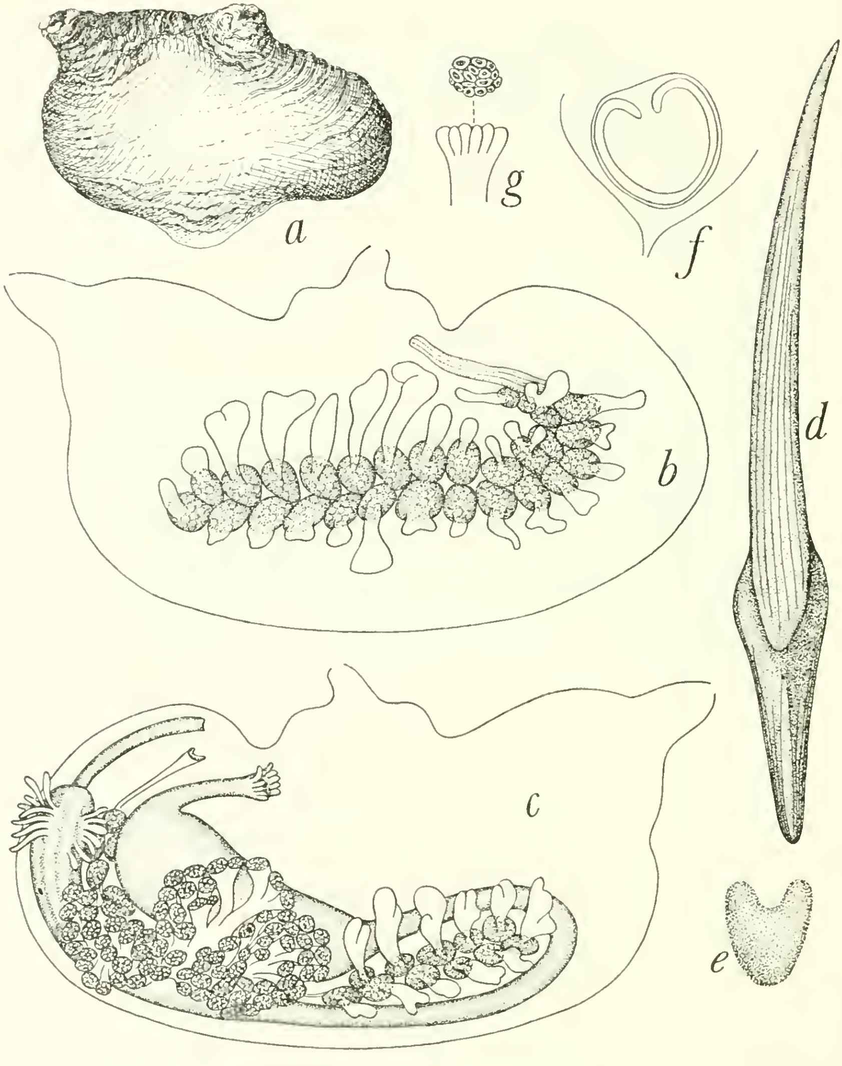

Figure 88.—*Pyura curvigona* Tokioka: *a*, the 26 mm. individual from Palau; *b*, right half of mantle body, inner side; *c*, left half of same; *d*, spinule from inner surface of siphons, highly magnified; *e*, outline of iridescent bodies, highly magnified; *f*, ciliated groove; *g*, tip of ramified branch from posterior part of liver.

on surface and partly emits bluish-green iridescence, which may be observed over nearly all of body surface of smallest specimen. This iridescence caused by spinules distributed in those parts of test and also found on inner surface of distal parts of siphons. Spinules very long, up to 275μ in length, each provided with a heart-shaped base (fig. 88*e*) which emits iridescence. Larger spinules striated with about 10 fibrous structures, their bases considerably elongated, attaining half of spinule's length. Mantle thick at siphonal area, but thin and

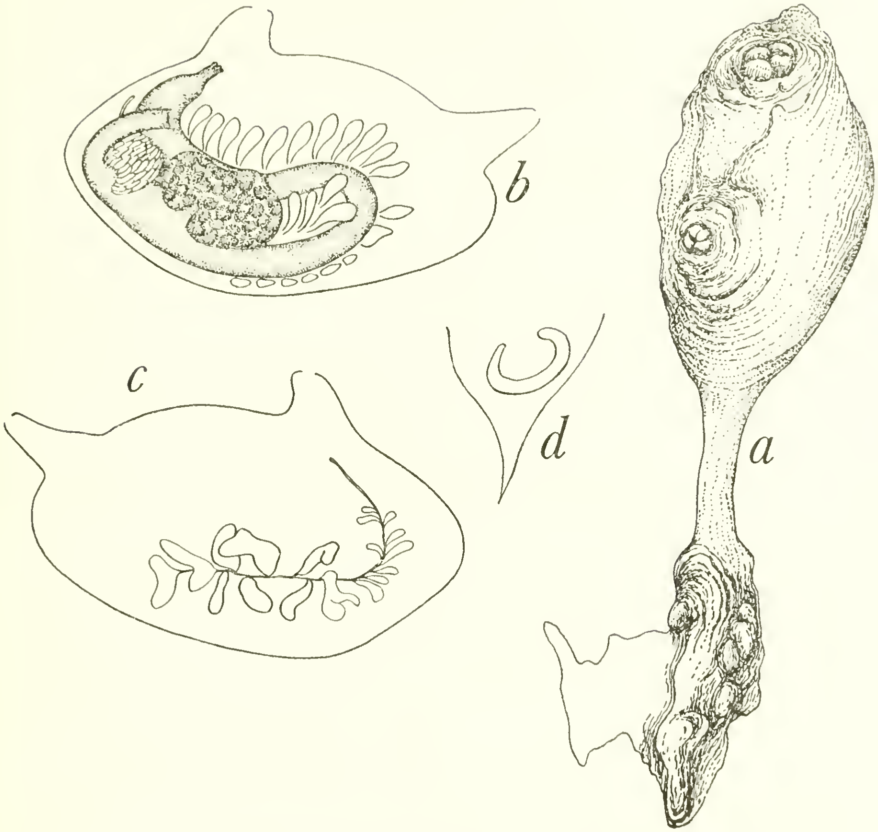

FIGURE 89.—*Pyura curvigona* Tokioka: *a*, 5 mm. individual; *b*, left half of mantle body, inner side; *c*, right half of same; *d*, ciliated groove.

translucent in other parts of body. Musculature fairly well developed, reddish salmon; consists of about 20 longitudinal muscles converging at branchial siphon, about 12 converging at atrial siphon and transverse muscles surrounding base of respective siphons. Branchial siphon subterminal, reddish; atrial short, situated near middle of body, both apertures 4-lobed.

Branchial sac reddish orange, with six folds on each side. Inner longitudinal vessels arranged (D=dorsal, V=ventral):

	26 mm. long individual														
Left	D	3	(11)	3	(10)	4	(11)	3	(18)	4	(15)	4	(10)	5	V
Right	D	2	(15)	4	(12)	4	(16)	4	(16)	3	(14)	5	(13)	4	V
	5 mm. long individual														
Right	D	1	(7)	1	(8)	1	(10)	2	(10)	2	(6)	2	(6)	1	V

Transverse vessels arranged: thick thin medium thin thick, every interval intervened by parastigmatic vessels. In smallest specimen, however, thicker and thinner vessels alternate rather regularly, parastigmatic vessels absent. Five to six elongated stigmata in each mesh in larger specimens, but only approximately two elliptical stigmata in a mesh in the smallest individual. Large tentacles about 10, smaller ones of same number; order of branching is two in larger specimens, but only first order is defined in smallest one. Ciliated groove simply U-shaped. First intestinal loop long, attaining two-thirds to three-quarters of body length. Esophagus long. Gastric region elongated, rectum swollen at bottom of second intestinal loop, anal margin cut into 7–11 lobules. Liver olive brown or brownish, distinctly divided into two parts in larger specimens, smaller anterior part consisting of a number of elongated finger-shaped hepatic lobules, larger posterior part consisting of a few complicatedly ramified protuberances of gastric region, which end distally in tufts of minute finger-shaped hepatic lobules (fig. 88*g*).

Gonads, especially the right, strongly curved in distal half; genital capsules each provided with an elongated endocarp on surface; endocarps of genital capsules of dorsal series larger than those of ventral series; 27–29 genital capsules on each side in larger specimens. Testicular follicles 10–25 on each capsule, occupying free surface; ovary located on attachment side. In smallest specimen gonad not mature, although a series of endocarps are on each side just at situation of gonad. Another series of endocarps found along outer side of intestinal loop on left side.

105. *Pyura vittata* (Stimpson)

FIGURE 90

Cynthia vittata Stimpson, 1852, p. 230.
Pyura vittata Van Name, 1945, p. 321, figs. 213–215; pl. 16, fig. 5 (synonymy).—Tokioka, 1953a, p. 273, pl. 3, figs. 3–4; pl. 66, figs. 1–5 (synonymy).

MATERIAL EXAMINED

PALAU ISLANDS: Iwayama Bay; south end of Island XX. GVF sta. 134. One specimen (USNM 11462).

DESCRIPTION.—A single 10 mm. long specimen from the Palau Islands attached to the substratum by the right ventral side was examined. Test milky white, with slightly yellowish tint around apertures, translucent and soft, but very tough; surface nearly smooth except for several wrinkles formed by contraction. Mantle extremely thin, yellowish white. Both siphons long, yellowish orange; apertures 4-lobed. About 10 longitudinal and transverse muscles, crossing each other regularly, around base of atrial siphon, basal portion of branchial siphon so mutilated that exact arrangement of muscles cannot be seen. Spinules on the inner surface of siphons slender (fig. 90*f*), 76μ in length on an average.

Six folds on each side of branchial sac. Inner longitudinal vessels arranged (D=dorsal, V=ventral):

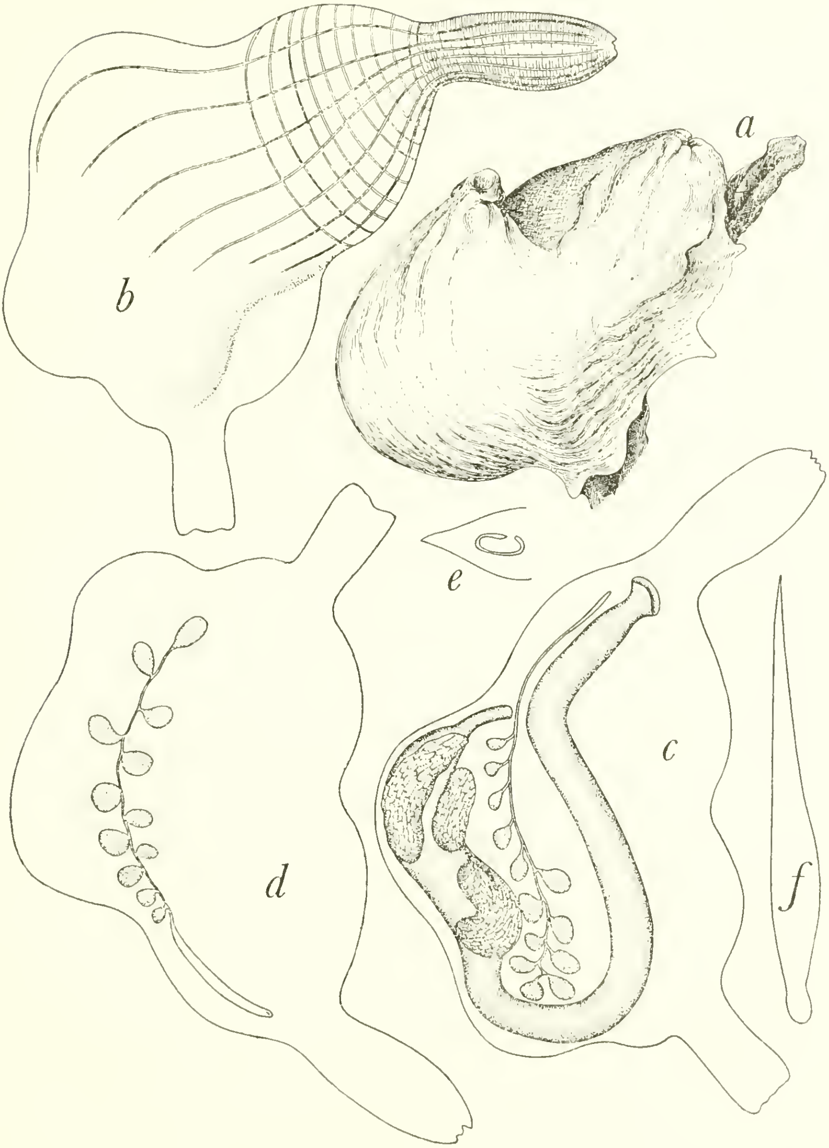

FIGURE 90.—*Pyura vittata* (Stimpson): *a*, specimen from Palau; *b*, mantle body, from right side; *c*, left half of mantle body, inner side; *d*, right half of same; *e*, ciliated groove; *f*, spinule from inner surface of siphons, highly magnified.

Left	D	1	(10)	2	(4)	2	(12)	2	(12)	2	(10)	1	(4)	1	V
Right	D	2	(10)	2	(6)	3	(12)	2	(9)	2	(3)	1	(2)	0	V

Second fold seems to be smaller than first or third fold. Two to three stigmata in each mesh, parastigmatic vessels present. Tentacles about 10(?); only branch of first order present, small, rather few. Ciliated groove C-shaped, opens towards left. Liver greenish brown, consists of three groups of rather elongated hepatic lobules. Anus margined plainly. Each gonad with 12–13 genital capsules, each capsule contains one or two eggs, one to three testicular follicles, and bears a minute endocarp on surface.

REMARKS.—Although the remarkable smallness of the second branchial fold seems to be unique for the present specimen, it very likely belongs to *Pyura vittata* and has attained maturity despite such a small body size.

106. *Pyura pachydermatina* (Herdman)

FIGURE 91

Boltenia pachydermatina Herdman, 1881, p. 81.—Herdman, 1882, p. 87, pl. 7, figs. 6–8.—von Drasche, 1884, p. 370.—Herdman, 1899, p. 16, pl. Cyn. 1.

Cynthia lutea Sluiter, 1900, p. 26, pl. 4, fig. 3; pl. 5, figs. 1–3.

Pyura pachydermatina Michaelsen, 1922, p. 389.—Brewin, 1946, p. 125, fig. 19; pl. 4, fig. 12d.—Brewin, 1950, p. 345.—Brewin, 1952, p. 192.—Kott, 1952, p. 262.—Brewin, 1958, p. 440.

MATERIAL EXAMINED

NEW ZEALAND: Port Chalmers. U.S. Navy Transit of Venus Expedition, Dr. E. Kerschner, coll., January 1875. One specimen (USNM 2676).

DESCRIPTION.—A single large stalked specimen from New Zealand was examined. Body elliptical, 62 mm. long and 25 mm. high. Peduncle 225 mm. long, 6 mm. in diameter, issues from anterior end of body; its surface irregularly creased, yellowish brown, covered with

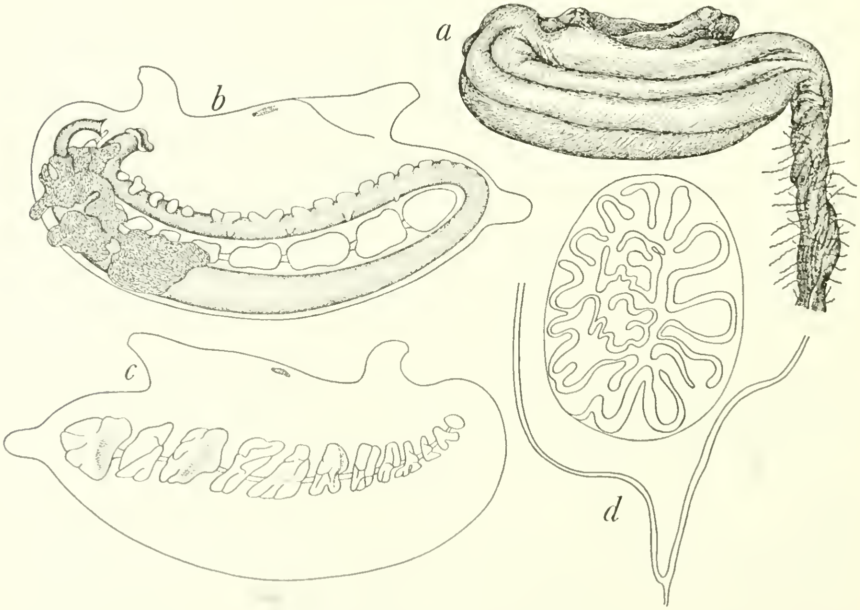

FIGURE 91.—*Pyura pachydermatina* (Herdman): *a*, right side of specimen; *b*, left half of mantle body, inner side; *c*, right half of same; *d*, ciliated groove.

network of hydroid stolons (*Sertularia* sp.). Branchial and atrial apertures open respectively at tip of short siphons situated approximately at level of each one-third of body length. Surface of body test yellowish white, with three deep longitudinal plications on each side. Test leathery and tough, rather thick along folds but only 1 mm. at thinner places between folds; inner surface whitish. Mantle thin and yellowish brown. Only longitudinal muscles converging at apertures prominent, although some circular muscles are found in neighborhood of bases of siphons.

Six folds on each side of branchial sac. Inner longitudinal vessels arranged (D=dorsal, V=ventral):

Right D 2 (13) 1 (17) 2 (18) 2 (17) 2 (14) 3 (12) 5 V

Transverse vessels arranged: 1 4 3 4 2 4 3 4 1 (numerals indicate order of thickness). Some parastigmatic vessels may be found here and there. Stigmata 9–12 in each mesh. Tentacles 37, arranged partly in the order: thick thin medium thin thick, branches very numerous and found in four orders. Ciliated groove describes a very complicated configuration. Intestinal loop very elongated. Liver very spacious. Approximately 20 endocarps along dorsal margin and 4 along ventral margin of distal branch of intestinal loop. Anus bilobed, each lip plainly margined. Genital capsules 12 on right, 13 on left side in intestinal loop.

REMARKS.—This is evidently a typical sea tulip or sea apple, a characteristic ascidian of the Australian-New Zealand waters.

107. *Herdmania mirabilis* (von Drasche)

Cynthia mirabilis von Drasche, 1884, p. 377, pl. 6, figs. 2–7.
Halocynthia mirabilis Oka, 1906a, p. 39.
Pyura mirabilis Van Name, 1945, p. 340, fig. 224.—Tokioka, 1954b, p. 93, pl. 7, fig. 26; pl. 8, figs. 27–33.—Tokioka, 1959a, p. 232.—Tokioka, 1965, p. 126.

MATERIAL EXAMINED

JAPAN: Hokkaido Island; Otaru. E. S. Morse, coll. One specimen (USNM 11687).

DESCRIPTION.—A single 45 mm. specimen from Japan, presented by the Tokyo Imperial University, was examined. Strongly contracted, test surface conspicuously wrinkled. Seven folds on each side of branchial sac, the seventh much smaller than the six other dorsal ones.

108. *Herdmania momus* (Savigny)

For references concerning the typical form of this species, see Van Name, 1945, p. 341; for references to the typical and other forms, see Tokioka, 1953a, p. 277.

MATERIAL EXAMINED

JAPAN: Honshu Island; off Manazuru Zaki N. 8° W., 4.5 mi.; *Albatross* sta. 3698. 33 specimens (USNM 11780).—Kyushu Island; Kagoshima. E. S. Morse, coll. Two specimens (USNM 11699).—Kyushu Island; Moji. E.S. Morse, coll. Three specimens (USNM 11702).

MARIANAS ISLANDS: Saipan; Tanapag Harbor. P. E. Cloud, sta. D-8. One specimen (USNM 11473).

DESCRIPTION.—Examined were 33 deep-water forms and 5 shallow-water forms from Japan and a single 18 mm. long specimen from Saipan Island. Shallow-water forms from the Japanese waters are 20–35 mm. in length, while deep-water forms are up to 65 mm. in length. Appearance of test seems to vary remarkably according to locality; soft, cartilaginous, yellowish white, and translucent in specimen from Saipan Island, but leathery, yellowish brown, rather tough in some shallow-water specimens from Japan, or extremely thin in deep-water forms, except for posterior portion of body in some individuals, test may be fairly thick in this portion. A bivalve shell, *Musculus* sp., was embedded in test of shallow-water forms from Japanese waters.

Calcareous spicules rather sparse in specimen from Saipan Island; 9 branchial folds on each side, ninth on left side very low; the 22 mm. long individual from Kagoshima, Japan, has 8 folds on each side, eighth not as tall as others on each side. Branchial sac often harbors parasitic copepods (Saipan specimen) or amphipods (Japanese deep-water forms). Alimentary canal located in posterior half of body in deep-water forms. Gonad seems to mature in a relatively small-body size in the tropics, is fully mature in specimen from Saipan. In deep-water forms gonad is situated near posterior end of body. Ovary occupies attachment side of gonad and testis covers free surface.

109. *Herdmania momus* var. *grandis* (Heller)

FIGURE 92

Cynthia grandis Heller, 1878, p. 97, pl. 5, fig. 26.
Cynthia complanata Herdman, 1882, p. 145, pl. 17, figs. 1–9.
Microcosmus Julinii von Drasche, 1884, p. 371, pl. 2, figs. 8–9; pl. 3, figs. 1–2.
Microcosmus draschii Herdman, 1899, p. 20, pls. Cyn. 3–4.
(For other references, see Kott, 1952, p. 279.)

MATERIAL EXAMINED

AUSTRALIA: Port Jackson. North Pacific Exploring Expedition, 1853–56, William Stimpson, coll., sta. SH 142. Three specimens (USNM 11767).

DESCRIPTION.—Three individuals collected at Port Jackson, Australia, were examined. Two are 85 mm., the other 160 mm. in length. Test leathery, or leathery in appearance but rather soft and cartilaginous; yellowish brown, strongly grooved on the surface, usually 1–2 mm. in thickness in the thinner dorsal portion, may reach 5–10 mm. thickness at some thickened parts on the ventral side. Section and inner surface of test whitish; mantle brownish, thick but rather soft. Spicules typical *momus*-type. Branchial aperture subterminal, atrial slightly posterior to middle of dorsal side. Branchial folds 12 (left)–13 (right) or 11(?) (left)–14 (right) in two 85 mm. long specimens, while 13 (left)–14 (right) in the 160 mm. long individual. Inner

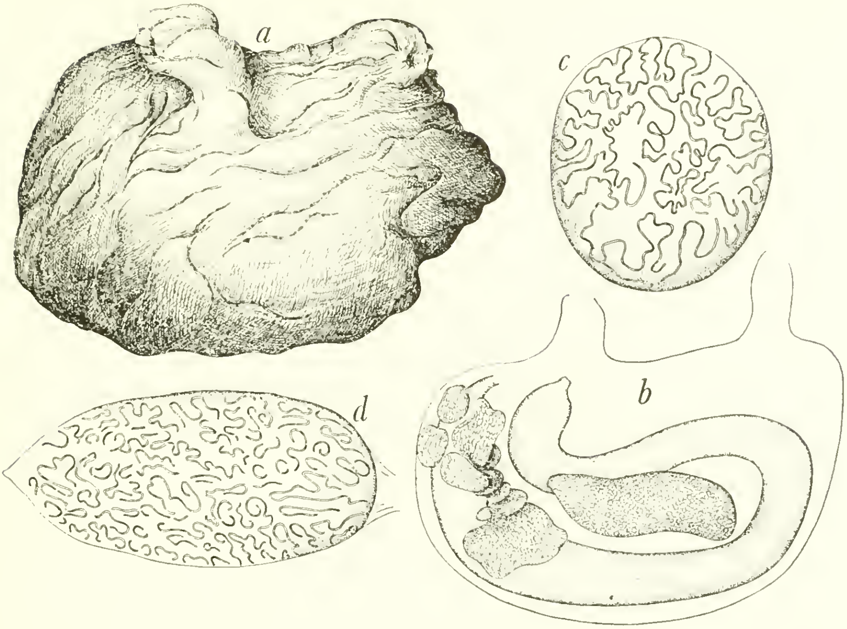

Figure 92.—*Herdmania momus* f. *grandis* (Heller): *a*, external appearance of an 85 mm. specimen; *b*, left half of mantle body of same specimen, inner side; *c*, dorsal tubercle of same specimen; *d*, dorsal tubercle of a 160 mm. specimen.

longitudinal vessels arranged on left side of an 85 mm. long specimen (D=dorsal, V=ventral):

D 8 (20) 3 (26) 3 (31) 4 (33) 2 (29) 5 (32) 5 (32) 2 (30)
3 (29) 4 (25) 3 (22) 1 (15) 0 V

Dorsal tubercle fairly large, round, about 5 mm. in diameter in an 85 mm. long individual (fig. 92*c*) or elliptical and 10 mm. long in the 160 mm. long individual (fig. 92*d*); ciliated groove represented by a number of undulating grooves. Tentacles 38 in an 85 mm. long individual; large, medium, and small tentacles differentiated and arranged: large small medium small large; branches in three orders. Many copepods and amphipods were found commensal in branchial sac in respective specimens. Gonad massive.

110. *Microcosmus exasperatus* Heller

FIGURES 93–97

Microcosmus exasperatus Heller, 1878, p. 99, pl. 3, fig. 19.—Van Name, 1945, p. 346, figs. 230–231; pl. 16, fig. 3 (synonymy).—Tokioka, 1952, p. 130, fig. 25.
Microcosmus kura Brewin, 1948, p. 136, fig. 9; pl. 9, figs. 5, 13D.
Microcosmus claudicans var. *australis* Kott, 1952, p. 288, figs. 139–144.

MATERIAL EXAMINED

China: Amoy; received October 12, 1932, from T. Y. Chen, University of Amoy; sta. 2, one specimen (USNM 11528); sta. 11, one specimen (USNM

11527); sta. 12, one specimen (USNM 11524); sta. 13, one specimen (USNM 11526); sta. 14, one specimen (USNM 11525); sta. 15, one specimen (USNM 11523).—Vicinity of Amoy; S. F. Light, coll. Ten specimens (USNM 11704).

Marianas Islands: Saipan; lagoon west of island, entrance to Tanapag Harbor; P. E. Cloud, Loc. 2. One specimen 8 mm. in length (USNM 11507).—Saipan; lagoon west of island, 500 yards NNE. of Managaha Id. P. E. Cloud, Loc. 4. Two specimens, 11 and 16 mm. in length (USNM 11505).—Saipan; lagoon west of island; Tanapag Harbor. P. E. Cloud, sta. D–8. One specimen, 9 mm. in length (USNM 11467).

Gilbert Islands: Onotoa Atoll. P. E. Cloud, sta. GOC–55. Two specimens 16 and 17 mm. in length (USNM 11493).

Australia: Port Jackson. North Pacific Exploring Expedition 1853–1856. William Stimpson, coll., sta. SH 142. One specimen 17 mm. in length (USNM 11759), on *Herdmania momus* var. *grandis* (Heller).

Description.—There are 24 specimens in the material, 17 from the coast of Amoy, China, 4 from Saipan Island of the Marianas Islands, 2 from the Gilbert Islands, and 1 from Port Jackson, Australia. As seen in the following descriptions, the Amoy specimens differ from those from Saipan, the Gilbert Islands, and Port Jackson in the appearance of the alimentary canal and the branchial tentacles. It is therefore convenient to describe these two groups of specimens separately at first, and then compare them with each other in detail.

Specimens from Amoy.—Up to 40 mm. in length excluding siphons and posterior extension of test in some specimens. Body roughly oval in shape, attached to substratum by ventral (left ventral in some specimens) or posteroventral side. Sometimes posterior part of test extended as long as body proper, so that animal is attached to substratum by this extended part of test, or many rooty protuberances issue from ventral side of animal and serve as attachment organs by grasping sand grains. Some specimens attached side by side, forming an aggregated mass. Both siphons prominent, reaching considerable length in some specimens. Branchial siphon terminal or subterminal, atrial situated near middle of dorsal side, both apertures 4-lobed. Test generally leathery and tough, thin, 0.5–1 mm. in thickness on dorsal side, but up to 2 mm. at some thickened places on ventral side; surface originally smooth, but irregularly wrinkled in various degrees by contraction, especially remarkably at siphons; holds a small amount of mud between the wrinkles or in the grooves, or covered partly by hydrozoans or other organisms. Color of test surface varies from pale yellowish brown to grayish brown, sometimes with a reddish tint, that of section and inner surface whitish, with pearly, pinkish or slightly purplish glistening. In a 30 mm. long individual, test may be described as hard, cartilaginous rather than leathery. Spinules on distal portion of inner surface of siphons sharply pointed, 35μ to 74μ (most frequently 60–65μ) in length with basal scaly part of nearly same length as spinule proper. Mantle of

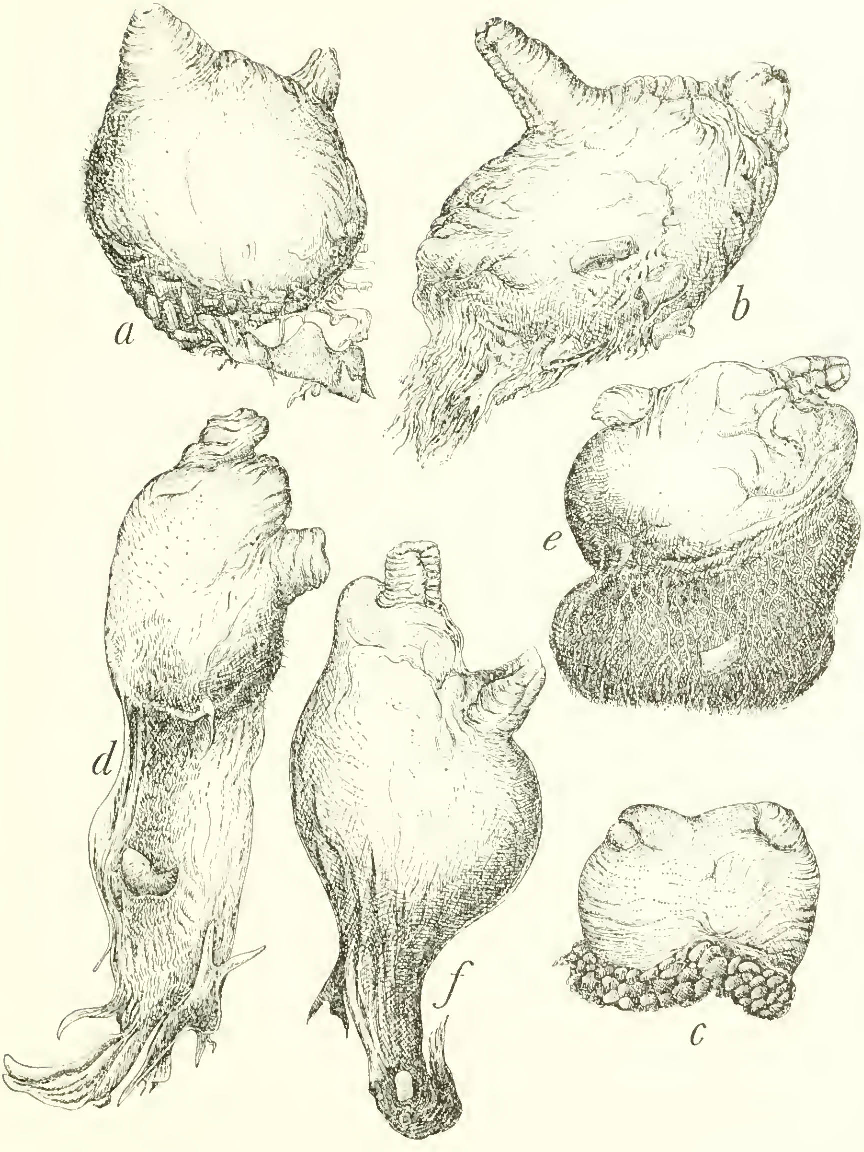

FIGURE 93.—*Microcosmus exasperatus* Heller: Specimens from Amoy: *a*, left side of 15 mm. specimen (USNM 11523); *b*, right side of 40 mm. specimen (USNM 11524); *c*, right side of 13 mm. specimen (USNM 11526); *d*, left side of 24 mm. specimen (USNM 11527); *e*, right side of 32 mm. specimen (USNM 11525); *f*, left side of 25 mm. specimen (USNM 11704).

moderate thickness in more or less contracted specimens, although thin in rather expanded specimens; pale yellowish brown or pale reddish brown. Longitudinal and transverse muscles very remarkable, crossing each other very regularly. The atrial velum bears a number of fine finger-shaped tentacles along inner basal portion.

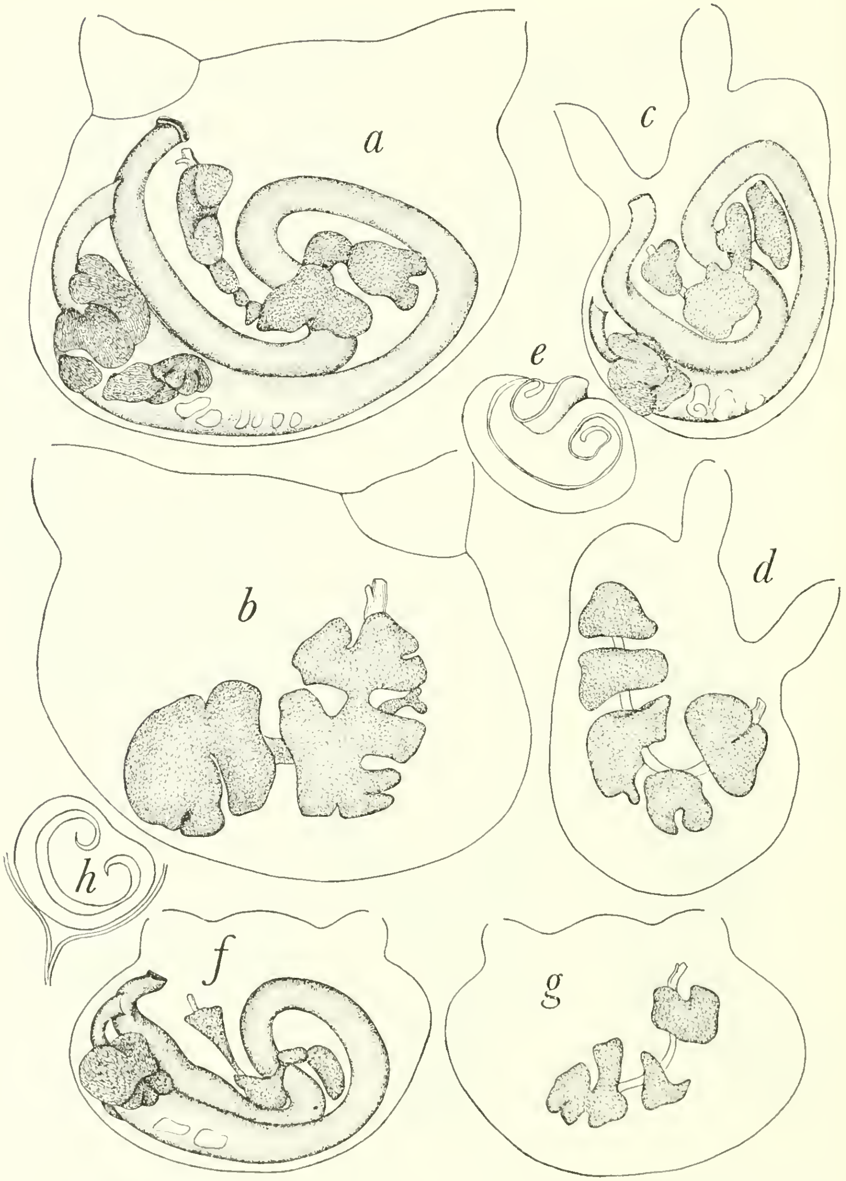

Figure 94.—*Microcosmus exasperatus* Heller: Specimens from Amoy: *a*, left half of mantle body of 35 mm. specimen, inner side (USNM 11523); *b*, right half of same; *c*, left half of mantle body of 25 mm. specimen, inner side (USNM 11704); *d*, right half of same; *e*, dorsal tubercle of same specimen; *f*, left half of mantle body of 13 mm. specimen, inner side (USNM 11526); *g*, right half of same; *h*, dorsal tubercle of same specimen.

In branchial sac 8 or 9 plications on left and 8 to 10 on right side, ventralmost fold usually rudimentary on each side, although well defined in anterior portion of branchial sac. Inner longitudinal vessels arranged (D=dorsal, V=ventral):

13 mm. long specimen (USNM 11525)

Left D 1 (14) 1 (12) 1 (16) 1 (14) 1 (13) 2 (11) 2 (9) 1 (3) 0 V
Right D 0 (13) 1 (12) 1 (16) 2 (13) 2 (13) 2 (13) 1 (12) 0 (5) 0 V

28 mm. long specimen (USNM 11704)

Left D 2 (20) 2 (19) 2 (20) 3 (20) 4 (18) 4 (15) 4 (13) 2 (10) 1 (3) 0 V
Right D 2 (17) 2 (18) 2 (21) 3 (21) 3 (18) 4 (20) 2 (17) 2 (13) 2 (6) 1 V

30 mm. long specimen (USNM 11704)

Left D 1 (21) 2 (20) 2 (21) 4 (21) 3 (19) 3 (18) 2 (15) 2 (11) 2 (5) 0 V
Right D 1 (16) 2 (18) 2 (22) 3 (19) 3 (18) 3 (19) 3 (16) 2 (14) 1 (11) 1 V

35 mm. long specimen (USNM 11523)

Left D 2 (21) 2 (19) 3 (21) 3 (20) 4 (19) 4 (18) 3 (15) 2 (11) 1 (3) 0 V
Right D 1 (20) 3 (18) 3 (23) 3 (21) 3 (22) 3 (20) 4 (18) 2 (14) 2 (11) 0 (3) 1 V

40 mm. long specimen (USNM 11524)

Left D 2 (20) 3 (19) 3 (22) 4 (19) 3 (19) 4 (18) 2 (17) 3 (11) 1 V
Right D 1 (19) 2 (17) 3 (19) 3 (22) 3 (21) 3 (19) 3 (17) 2 (13) 1 (9) 1 V

Arrangement of transverse vessels varies from: 1 p 3 p 2 p 3 p 1 (13 mm. long specimen) to 1 4 3 4 2 4 3 4 1, 1 333 2 333 1 or 1 444 3 444 2 444 3 444 1, excluding parastigmatic vessels (numerals indicate order of thickness of vessels, p represents parastigmatic vessel). Parastigmatic vessels found most commonly in posterior portion of branchial sac. Elliptical stigmata 5 to 8 in each mesh. Tentacles 21 (13 mm. long individual) to 35 (25 mm. long individual), arranged partly in order: large small medium small large; also minute ones found at some intervals; branches in 4 to 5 orders, very complicated. Ciliated groove roughly U-shaped with both horns strongly incurled; frequently slightly inclined towards right side as seen from front.

Second intestinal loop very deep, axis passes through approximately middle of ventral branch of first intestinal loop. From 2 to 6 endocarps on intestinal wall just posterior to hepatic region. Liver pale reddish brown in preserved specimens; minute finger-shaped papillae on each hepatic lobule. Anal margin mostly plain, though rarely undulating and forming several indistinct lobules. Left gonad consists of 3 to 4 genital capsules (and several small ones in rare cases), right consists of 2 to 5 capsules. Ovary occupies free surface of gonad and testis is spread along attachment surface.

Specimens from Saipan, the Gilbert Islands, and Port Jackson.—Specimens from Saipan 8–16 mm. in length, those from the Gilbert Islands 16–17 mm., and the Australian specimen 17 mm. long. Attached to substratum by ventral side, slightly inclined to left or right side, or by left side of body. Both siphons rather short, branchial terminal or subterminal, atrial located in most specimens slightly posterior to middle of body. Test leathery, thin, varies from yellowish

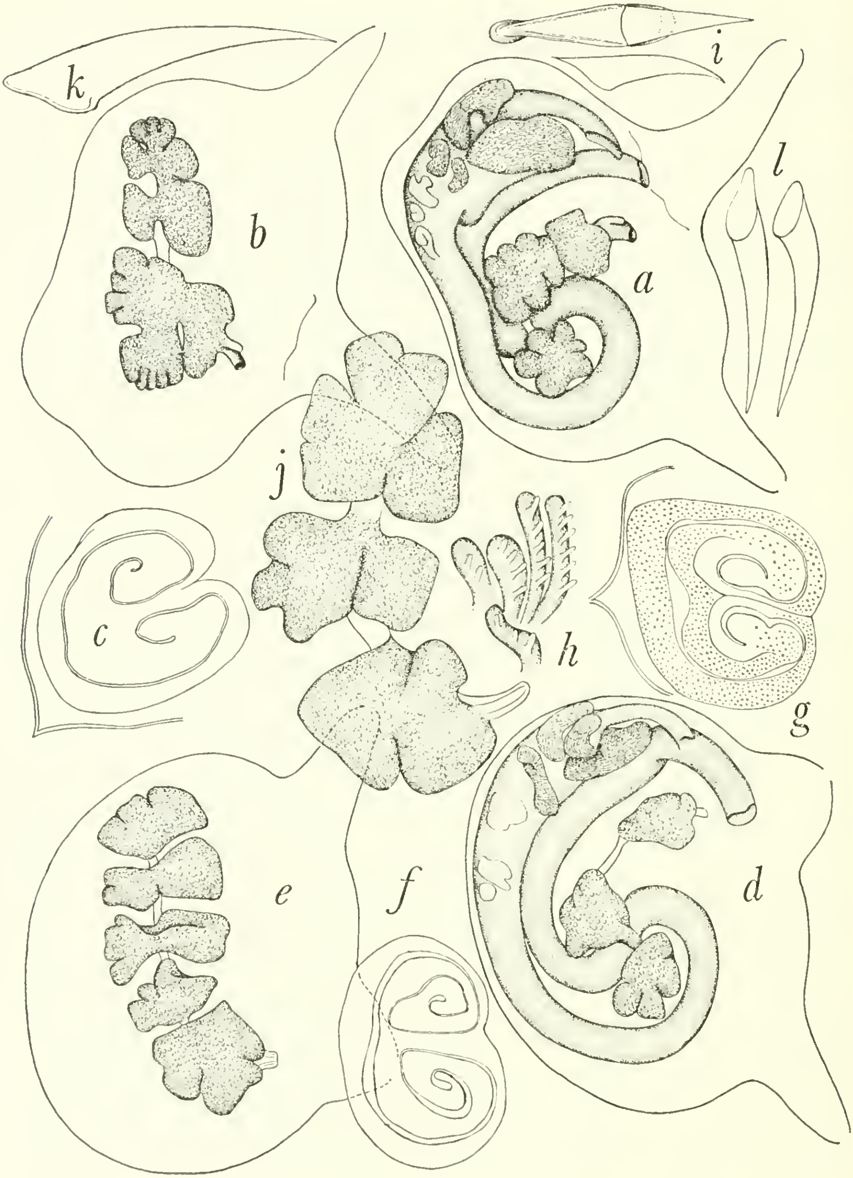

Figure 95.—*Microcosmus exasperatus* Heller: Specimens from Amoy: *a*, left half of mantle body of 40 mm. specimen, inner side (USNM 11524); *b*, right half of same; *c*, dorsal tubercle of same specimen; *d*, left half of mantle body of 30 mm. specimen, inner side (USNM 11704); *e*, right half of same; *f*, dorsal tubercle of same specimen; *g*, dorsal tubercle of 35 mm. individual (USNM 11523); *h*, part of the liver from same specimen, magnified; *i*, spinules from inner surface of siphons same specimen, highly magnified; *j*, right gonad of 30 mm. specimen (USNM 11704); *k*, spinule from inner surface of siphons of same specimen, highly magnified; *l*, spinules from inner surface of siphons of 28 mm. specimen, highly magnified (USNM 11704).

white to brownish, dorsal side partly dark brownish. Inner surface of test whitish to pale brownish. Surface wrinkled and often carries fine mud. Spinules on inner surface of distal portion of siphons very minute and somewhat conical in shape. Mantle of considerable thickness with well-defined musculature consisting of longitudinal and transverse muscles. Coloration yellowish white to yellowish brown or brownish to reddish brown. Minute villus-like protuberances occur sparsely on atrial velum and also on soft inner surface of basal portion of siphons. Branchial plications 7 (8 mm. long individual) to 9 on left and 8 or 9 on right side. Ventralmost fold on left side rudimentary in some specimens.

The Australian specimen shows following arrangement of inner longitudinal vessels:

Left D 1 (19) 1 (13) 2 (17) 2 (17) 2 (14) 2 (15) 1 (13) 1 (12) 0 (3) 0 V
Right D 1 (16) 1 (14) 1 (19) 1 (18) 2 (16) 2 (13) 1 (12) 1 (12) 0 (7) 0 V

The 16 mm. long specimen from the Gilbert Islands shows following arrangement:

Left D 3 (18) 2 (15) 2 (19) 2 (18) 2 (18) 2 (16) 1 (15) 1 (11) 0 V
Right D 2 (14) 1 (15) 1 (21) 1 (20) 1 (17) 1 (16) 2 (13) 1 (12) 1 (9) 0 V

Transverse vessels arranged: 1 p 2 p 1, or 1 p 3 p 2 p 3 p 1. Six to nine elongated stigmata in each mesh. Tentacles rather simple, with branches in two (Saipan specimens and one of the Gilbert Islands specimens) or three (Australian specimen and one of the Gilbert Islands specimens) orders. Tentacles 18–20, large and small, also some minute ones at intervals. Second intestinal loop distinct; axis does not seem to pass through middle of ventral branch of first intestinal loop, but rather bottom of second loop seems to touch or reach near hepatic region of ventral branch. Anal margin plain. Three endocarps on intestinal wall just posterior to hepatic region in the 16 mm. long specimen; no such appendages found in other specimens. Liver yellowish brown in preserved specimens. Two to six genital capsules on left and two to seven on right side; capsules placed rather closely to each other so that gonad in some specimens looks as if it consisted of only a single mass irregularly lobated into a few or several lobes.

Remarks.—The differences between the Amoy specimens and those from Saipan, the Gilbert Islands, and Port Jackson are considered to be insignificant as specific characteristics. However, the differences found in the branching order of the branchial tentacles, the feature of the second intestinal loop, and in the appearance of the gonad are rather noteworthy. It is not impossible that the last two of the three differences are attributable to body size of the specimens, although such differences may be clearly observed between a certain small specimen from Amoy (13 mm. long) and Saipan and Australian specimens (8–17 mm. long). The first of the three differences, however, seems

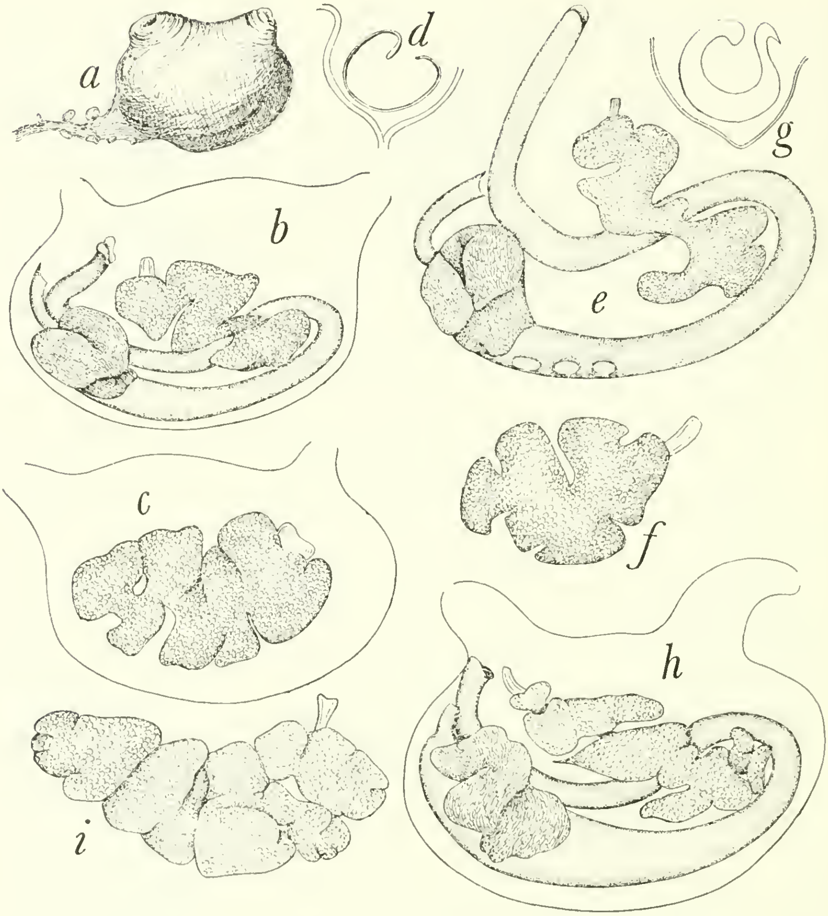

FIGURE 96.—*Microcosmus exasperatus* Heller: *a–g*, Specimens from Saipan Island: *a*, right side of 8mm. specimen (USNM 11507); *b*, left half of mantle body of same specimen, inner side; *c*, right half of same; *d*, ciliated groove of same specimen; *e*, intestinal loop and gonad from 16 mm. specimen; *f*, right gonad of same specimen; *g*, ciliated groove of same specimen. *h*, *i*, Specimen from Port Jackson: *h*, left half of mantle body of 17 mm. specimen, inner side; *i*, right gonad of the same specimen.

to be unique; even the 13 mm. long Amoy specimen has tentacles with branches in four orders and the 20 mm. long specimen from the same locality bears tentacles with branches in five orders, while the 16 mm. long Saipan specimen has tentacles with branches in only two orders and the 17 mm. long Australian specimen has tentacles with branches in three orders. In 19–32 mm. long specimens from the Arafura Sea, described in my previous paper (Tokioka, 1952), branches of the tentacles were also in only two orders. This feature may be used as a clue to distinguish two groups if it is concluded in the future that two races or forms are recognizable in *Microcosmus exasperatus*, after more cru-

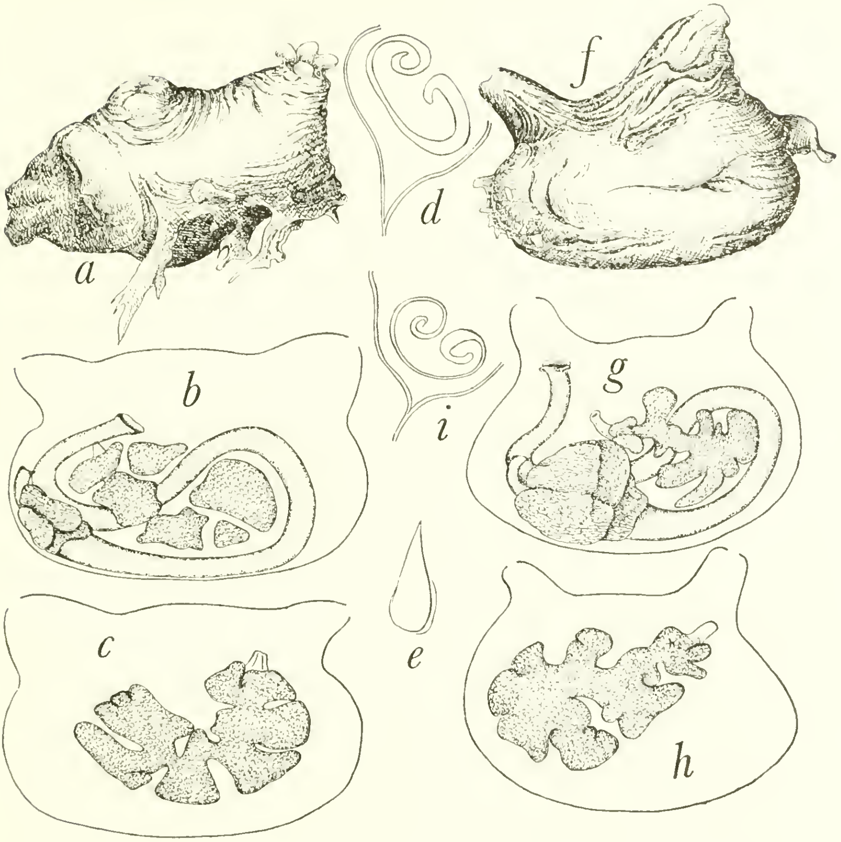

Figure 97.—*Microcosmus exasperatus* Heller: Specimens from the Gilbert Islands: *a*, right side of 16 mm. individual; *b*, left half of mantle body of same specimen, inner side; *c*, right half of same; *d*, ciliated groove of same individual; *e*, spinule from inner surface of siphons of same specimen, highly magnified; *f*, right side of 17 mm. individual; *g*, left half of mantle body of same specimen, inner side; *h*, right half of same; *i*, ciliated groove of same individual.

cial studies are made on many more specimens from various localities.

The smallness of the Saipan specimens might indicate that the ocean-island inhabitants become smaller. The complicated ramification of the branchial tentacles in Amoy specimens might be considered effective in preventing the inflow of silt or detritus, which might be more abundant in the littoral water along the coast near Amoy than in other localities.

111. *Microcosmus curvus* Tokioka

Figures 98, 99

Microcosmus curvus Tokioka, 1954a, p. 263, pl. 37, figs. 2–9.

MATERIAL EXAMINED

Palau Islands: Iwayama Bay; south end of Guazima (Island XV); GVF sta. 92. One specimen 10 mm. long (USNM 11408) found with sponges.

Marianas Islands: Saipan; lagoon west of island, 500 yds. NNE. of Managaha Island; P. E. Cloud, loc. 4. One specimen 7 mm. long (USNM 11503).

Wake Island: C. H. Edmondson, sta. 607. Three specimens 9 to 10 mm. long (USNM 11760).—C. H. Edmondson, sta. 608. Three specimens 12 to 13 mm. long (USNM 11761).

Description.—Six specimens (9–13 mm. long) from Wake Island, one specimen (7 mm. long) from Saipan Island, and a single 10 mm. long specimen from the Palau Islands were examined. Animal roughly spherical or elliptical in shape, usually attached to substratum by right ventral side. Both siphons distinct in Palau specimen, but nearly sessile on others more or less contracted. Branchial siphon subterminal, atrial subterminal or situated near middle of dorsal side; apertures 4-lobed, separated from each other by about half of body length. Test leathery, thin but very tough; coloration varies from yellowish white to yellowish brown or grayish brown in preserved state, inner surface whitish with pearly glistening; surface originally smooth but generally irregularly wrinkled in contracted specimens, especially areas around apertures furnished with small irregularly shaped swellings. Mantle reddish brown to dark reddish, rather thin, although dorsal side may be thickened considerably in some specimens. Fine villus-like protuberances on atrial velum and also on proximal inner surface of siphons. Distal inner surface of siphons covered with many minute spinules.

Six branchial plications in smaller specimens and seven to eight in larger ones. Inner longitudinal vessels arranged (D=dorsal, V=ventral):

7 mm. long specimen (from Saipan)
Left D 1 (11) 1 (6) 1 (10) 1 (10) 1 (8) 1 (4) 1 V
Right D 1 (10) 1 (6) 1 (9) 2 (9) 2 (7) 1 (6) 0 V

10 mm. long specimen (from Palau)
Left D 1 (12) 1 (9) 1 (13) 2 (11) 1 (9) 1 (6) 1 V
Right D 1 (13) 1 (7) 1 (13) 2 (12) 1 (9) 1 (8) 1 V

12 mm. long specimen (from Wake)
Left D 1 (15) 1 (13) 1 (16) 3 (12) 2 (11) 2 (7) 1 (3) 0 V
Right D 1 (13) 0 (12) 1 (14) 1 (13) 1 (14) 2 (8) 0 V

12 mm. long specimen (from Wake)
Left D 1 (15) 1 (12) 1 (15) 2 (13) 2 (11) 1 (7) 1 (3) 1 V
Right D 1 (11) 1 (11) 1 (17) 2 (13) 2 (12) 2 (8) 1 (4) 0 V

13 mm. long specimen (from Wake)
Left D 2 (17) 1 (11) 2 (17) 2 (14) 2 (11) 1 (9) 1 (8) 0 (6) 0 V
Right D 2 (14) 1 (13) 2 (17) 2 (13) 3 (10) 2 (10) 1 (6) 0 V

Ventralmost fold may be rudimentary in some specimens. Transverse vessels found in following arrangement: 1 P 2 P 1, 1 P 2 P 2 P 2 P 1, or 1 P 3 P 2 P 3 P 1 (numerals indicate orders of thickness of vessels, P represents parastigmatic vessel). Stigmata elongated, generally 3 to 5

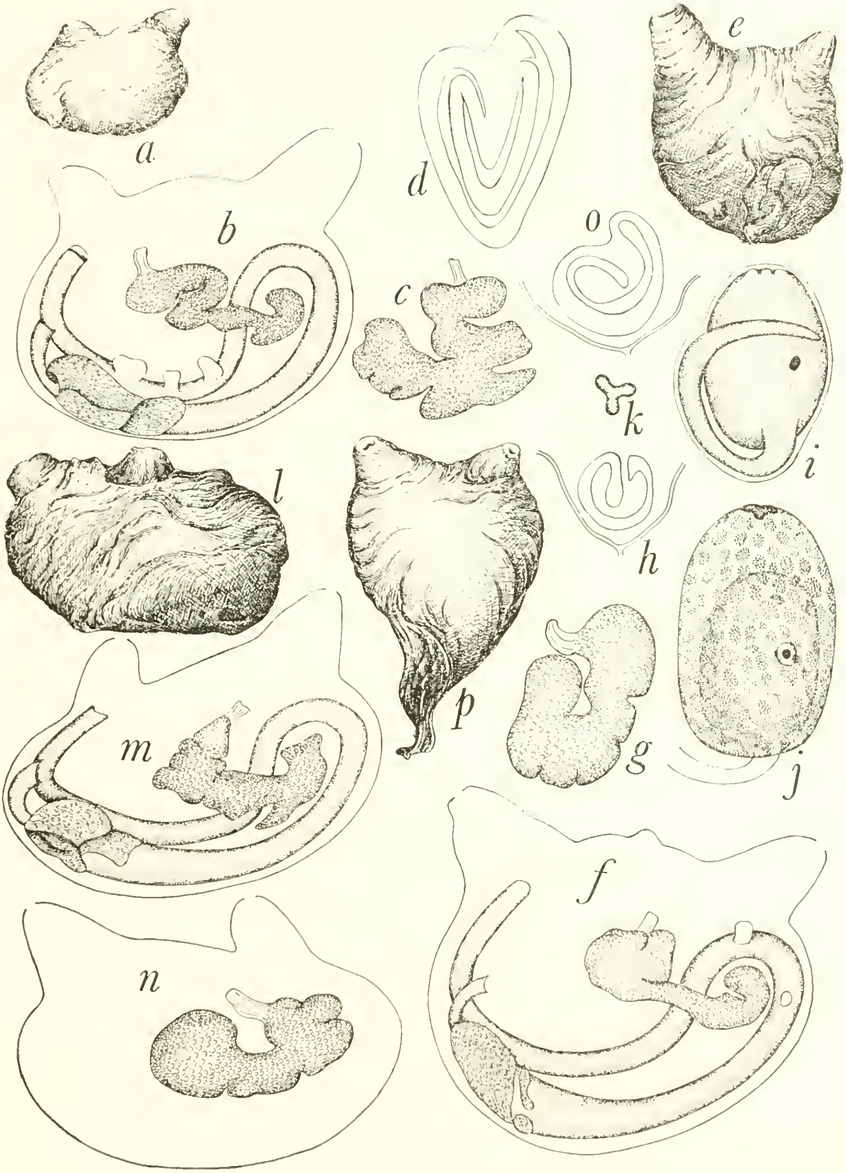

FIGURE 98.—*Microcosmus curvus* Tokioka: Specimens from Wake Island: *a*, right side of 13 mm. specimen, sta. 608; *b*, left half of mantle body of same specimen, inner side; *c*, right gonad; *d*, ciliated groove of same specimen; *e*, left side of 12 mm. specimen, sta. 608; *f*, left half of mantle body of same specimen, inner side; *g*, right gonad; *h*, ciliated groove of same specimen; *i*, larva from same specimen; *j*, trunk of larva; *k*, apical view of attachment process; *l*, left side of 12 mm. specimen, sta. 608; *m*, left half of mantle body of same specimen, inner side; *n*, right half of same; *o*, ciliated groove of same specimen; *p*, 9 mm. individual, sta. 607.

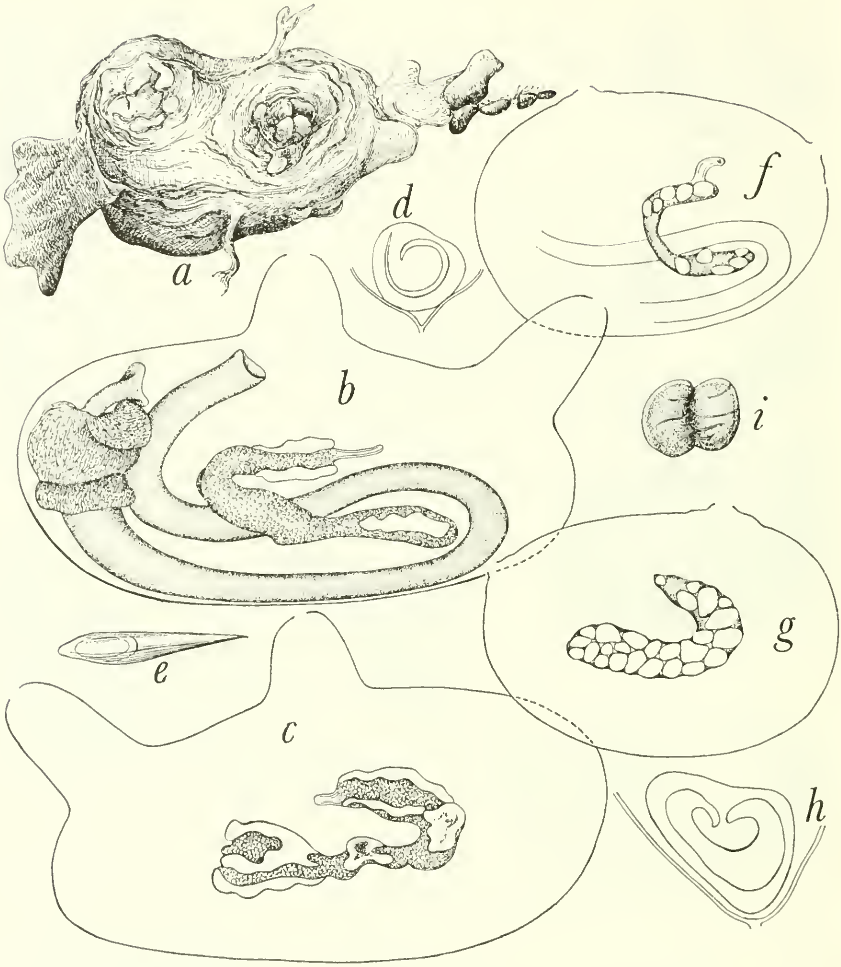

FIGURE 99.—*Microcosmus curvus* Tokioka: Specimens from Palau and Saipan: *a*, dorsal side of specimen from Palau; *b*, left half of mantle body of same specimen, inner side; *c*, right half of same; *d*, ciliated groove of same individual; *e*, spinule from distal inner surface of siphons, highly magnified; *f*, left half of mantle body of specimen from Saipan, inner side; *g*, right half of same; *h*, ciliated groove; *i*, anal lobes of same specimen.

in each mesh, but may be up to 9 in large meshes along endostyle. Tentacles 11 to about 20 in number, usually larger and smaller ones differentiated; also minute ones intervene at some intervals; branches in 2 orders. Ciliated groove U-shaped, with one or both horns incurled; in the 13 mm. long specimen from Wake Island, groove represented by two crescent clefts (fig. 98*d*).

Bottom of second intestinal loop touches hepatic region of ventral branch of first intestinal loop. Anal margin plain, but may undulate and sometimes form several irregular lobules. Liver pale brownish in preserved specimens. Generally gonad curves strongly as is shown in original description, although not curved so much on left side of the 13 mm. long specimen from Wake Island (fig. 98*b*). Ovary dark reddish.

Trunk of larva ellipsoidal in shape, 330μ in length. Tail first laid along ventral side of trunk, turns to left at right angles, then proceeds along left side of trunk to reach near dorsal edge slightly in front of sensory organ situated slightly posterior to the middle of body. Three attachment processes small, together form a small, low triangular prominence (fig. 98*k*). Larval test wholly sprinkled with small dotted flecks.

REMARKS.—The Saipan and Palau specimens are provided with typical curved gonads and fewer branchial plications (6), while the specimens from Wake Island have more (6 to 8) branchial plications and show some resemblance to *Microcosmos exasperatus* in the appearance of the lobated gonad. Thus, it is not impossible that the present species is continuous with the small-sized specimens of *M. exasperatus* known from some ocean islands, and it would represent an extremity of wide variation, opposite the specimens from the coast of Amoy, which are considered to represent the other extremity of the variation.

112. *Halocynthia roretzi* (von Drasche)

(*Styela?*) *Cynthia Roretzii* von Drasche, 1884, p. 376, pl. 5, figs. 4–8; pl. 6, fig. 1.
Halocynthia roretzi Tokioka, 1953a, p. 282, fig. 20; pl. 71, figs. 1–4; pl. 72, figs. 1–11. (Synonymy.)

MATERIAL EXAMINED

JAPAN: Hokkaido Island; Otaru. K. Katakura, collector; *Albatross* Exped. One specimen (USNM 11784).

DESCRIPTION.—A single specimen, 150 mm. long, is in the collection. Protuberances on body surface are all stout.

113. *Halocynthia aurantium* (Pallas)

Ascidia aurantium Pallas, 1787, p. 240, pl. 7, fig. 38.
Halocynthia aurantium Van Name, 1945, p. 362, pl. 31, fig. 1. (Synonymy.)—Tokioka, 1951a, p. 17, fig. 13.

MATERIAL EXAMINED

JAPAN: Hokkaido Island; Otaru. E. S. Morse, coll. Two specimens (USNM 11689).

REMARKS.—The two specimens examined were collected at Otaru of Hokkaido Island, Japan, and presented to the U.S. National Museum from the Tokyo University in an exchange of specimens. They are respectively 17 mm. and 30 mm. long, excluding a tuft of rooty protuberances about 15 mm. in length. The preservative alcohol is a deep orange, indicating that the animals were evidently orange red when alive.

114. *Culeolus easteri*, new species

Figure 100

Holotype.—USNM 11769: Off Marquesas Islands; 0°50′00″ N., 137°54′00″ W.; 2,463 fathoms, gray yellow *Globigerina* ooze. *Albatross* sta. 3684, September 10, 1899.

Description.—The holotype is a single specimen from off the Marquesas Islands, 15 mm. in length. Body ellipsoidal, attached to substratum by a slender stalk 53 mm. long, 0.6–0.7 mm. in diameter. Surface of stalk marked with 13 longitudinal ridges (fig. 100*d*). Branchial aperture distinctly 4-lobed, located slightly dorsal to insertion point of stalk at anterior end of body. Atrial aperture a slitlike opening on dorsal side at level of approximately a quarter of the body length from the posterior end of the body. Test yellowish brown, leathery, rather thin, section and inner surface whitish. Surface entirely covered with many minute prominences, also two transverse rows of comparatively large conical prominences, one at level of branchial aperture, other at middle of range between apertures and confined to dorsal half of body; consists of about 20 prominences which diminish in size ventrally. Terminal of inserted stalk reaches near level of posterior margin of branchial aperture. Mantle extremely thin, with rather sparse longitudinal and transverse muscles.

As the specimen was already cut open by Dr. de Laubenfels when it was sent to him for identification as a sponge-like organism, the internal organs were so torn that an accurate description of the branchial sac can hardly be given here. Probably five plications on each side. Arrangement of the inner longitudinal vessels on left side seems to be (D=dorsal, V=ventral).

D 0 (8) 1 (5) 2 (7) 2 (6) 1 (4) 2 V

Wall of branchial sac shows a kind of meshwork consisting of longitudinal and transverse vessels but being devoid of true stigma. Ciliated groove a crescent. Tentacles 21, larger and smaller ones differentiated; only branches of first order are seen and are rather few. No spicules found in any vessels. Dorsal lamina represented by series of dorsal languets. Intestinal loop situated in posterior half of body, second loop practically indiscernible. Anal margin cut into about 10 lobules. Two gonads on each side, posterior gonad a single mass, while anterior one consists of two genital capsules. On left side, posterior gonad found in intestinal loop, but anterior one situated in anterior half of body outside intestinal loop.

Remarks.—Of the Pacific species of *Culeolus*, *C. herdmani* Sluiter and *C. quadrula* Sluiter differ distinctly from the present new species in the situation of the inserted part of the stalk, in the arrangement of rows of large conical prominences on the body surface, and also in the structure and arrangement of two gonads on each side. *C.*

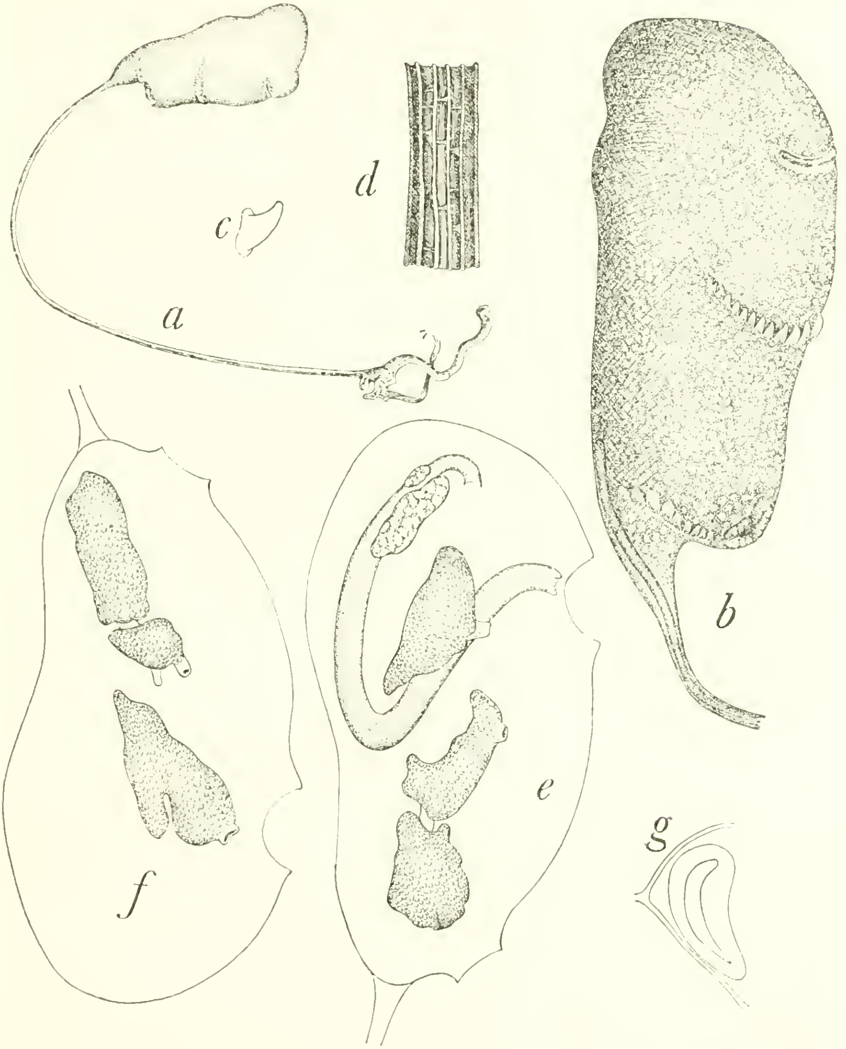

FIGURE 100.—*Culeolus easteri*, new species: *a*, entire animal; *b*, right side of body; *c*, conical prominence on test surface; *d*, part of stalk, magnified; *e*, left half of mantle body, inner side; *f*, right half of same; *g*, dorsal tubercle.

inversus Oka, 1928, from the western Pacific (13°26′ N. × 145°40′ E., 3,500 m.) is unique in the situation of the atrial aperture on the ventral side and in having an unusually large branchial aperture. *C. murrayi* Herdman, *C. gigas* Sluiter, and *C. thysanotus* Sluiter each have a single gonad on each side; the last one especially cannot be confused with others because of its peculiar external appearance. *C. moseleyi* Herdman from a *Challenger* station in the Central Pacific, not far from the locality of the present specimen, and *C. annulatus* Sluiter from the *Siboga* area are devoid of the row of distinct papillae defining the posterior area surrounding the atrial aperture; on the other hand the complete lack of descriptions of the gonad in these species makes it difficult to compare these two forms with this new species. *C. wyville-thomsoni* Herdman, collected at a *Challenger* station in the South Pacific has six branchial plications on each side and evidently differs from this new species in external appearance, although comparison of the gonad cannot be made between *C. wyville-thomsoni* and the present new species because of the complete absence of description of this organ in the former. Ritter's *C. pyramidalis* from the foot of the continental slope west of San Diego, California, cannot be compared exactly with the present new species, as the internal structure of the specimens was evidently damaged; his *C. sluiteri* from just south of the Aleutian Islands differs distinctly from others by its unique structure of gonads. Some of the specimens collected by the *Galathea* at the stations in Kermadec Trench and provisionally treated by Millar (1959) under *C. suhmi* Herdman very closely resemble the present new species in internal structure, including the branchial sac and gonad, and in the manner of the stalk insertion into the body. However, the arrangement of the prominent papillae on the body surface and the surface structure of the stalk seem to differ clearly between these specimens and the present new species.

Family Molgulidae

115. *Molgula (Molgula) xenophora* Oka

FIGURE 101

Molgula xenophora Oka, 1914, p. 457, figs. 15–16.

MATERIAL EXAMINED

JAPAN: Hokkaido Islands; Hakodate. E. S. Morse, coll., 35 specimens (USNM 11697).

DESCRIPTION.—The 35 specimens presented in exchange from Tokyo Imperial University were examined. Unfortunately most of them were damaged, but 7 were found in comparatively perfect condition. Body ellipsoidal, attains 42 mm. in length; surface densely or sparsely encrusted with fine black sand grains, which also impregnate the test; thus test thickens, attaining 2–3 mm. in thickness in larger specimens. Some specimens attached to each other, hairy attachment processes from ventral side being entangled. Apertures practically invisible from surface, although narrow siphonal area is discernible on dorsal side, being slightly depressed. On inner surface of test, apertures situated about 7 mm. apart in 34–40 mm. long individuals. Mantle soft, thin, brownish. Transverse body muscles represented by many short pieces of muscle scattered over mantle surface (fig. 101*b*, *c*); generally 3 pairs of longitudinal rows of these muscle pieces in anterior half of body, 7 rows (3 on right, 4 on

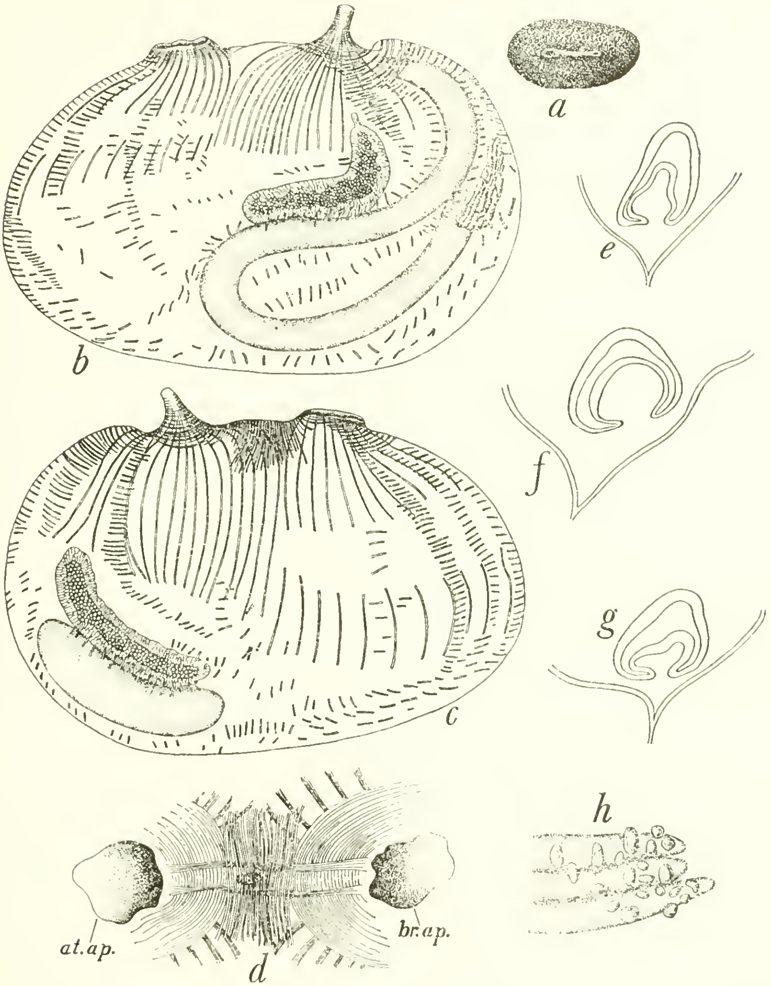

FIGURE 101.—*Molgula* (*Molgula*) *xenophora* Oka: *a*, dorsal side of animal; *b*, left side of mantle body; *c*, right side of same; *d*, neural area surrounding dorsal ganglion; *e–g*, ciliated grooves of 42, 40, and 34 mm. individuals, respectively; *h*, part of liver, magnified.

left side) in posterior half. Longitudinal muscles inside transverse muscle pieces; muscles converging at atrial aperture all perfect, those gathering at branchial aperture widely interrupted. Area surrounding dorsal ganglion wholly covered with fine transverse muscles (fig. 101*d*). Kidney sac in posterior part of body with anterior end at level of frontal margin of atrial aperture.

In branchial sac seven plications present on each side. Inner longitudinal vessels arranged (D=dorsal, V=ventral):

34 mm. long specimen

Left	D	0	(12)	0	(14)	0	(15)	0	(15)	0	(13)	0	(13)	0	(9)	0	V
Right	D	1	(13)	0	(14)	0	(14)	0	(15)	0	(15)	0	(15)	0	(13)	0	V

40 mm. long specimen

Left	D	0	(13)	0	(14)	0	(16)	0	(18)	0	(16)	0	(15)	0	(10)	0	V
Right	D	0	(16)	0	(17)	0	(18)	0	(18)	0	(15)	0	(15)	0	(12)	0	V

One transverse row of infundibula in each interval between transverse vessels, in all up to 15 infundibular rows. Tip of each infundibulum usually divided into two apexes, which are then situated along distal margin of branchial plication, although not bifid at some places. Tentacles up to 20, larger and smaller differentiated, also minute ones in intervals; branches in 3 orders. Ciliated groove C-shaped, opens posteriorly.

Anterior margin of intestinal loop attains posterior base of branchial aperture. Anal margin plain. Gastric region with a dozen irregular longitudinal plications, from which minute hepatic lobules protrude (fig. 101*h*). Single elongated gonad on each side, right one along dorsal side of kidney sac, left one along dorsal margin of distal branch of intestinal loop. Ovary occupies axial portion of gonad, fringed by testis along margin.

REMARKS.—This species closely resembles *Molgula* (*Molgula*) *interrupta* Tokioka, but the former can be distinctly distinguished from the latter in the appearance of the musculature. In *M.* (*M.*) *interrupta* all the longitudinal muscles are cut in pieces, just as the transverse muscles are, and the arrangement of the transverse muscle pieces is not as complicated as in *M.* (*M.*) *xenophora;* the neural region surrounding the dorsal ganglion is quite free from any muscle in *M.* (*M.*) *interrupta.* The ciliated groove of Oka's original specimens is described as horseshoe-shaped and opened to the right side, slightly inclined anteriorly. This feature differs somewhat from that of the present specimens. The discrepancy must be discussed fully in the future on more specimens from various localities.

116. *Hartmeyeria orientalis* Oka

FIGURE 102

Hartmeyeria orientalis Oka, 1929, p. 351, figs. A–C.—Tokioka, 1953a, p. 295, fig. 25; pl. 78, figs. 6–11.
Hartmeyeria longistigmata Tokioka, 1949a, p. 11, pl. 5, figs. 4–7.

MATERIAL EXAMINED

JAPAN: Kyûshû Island; Kagoshima. E. S. Morse, coll. Specimens 21 (USNM 11698).—Kyûshû Island; Moji. E. S. Morse, coll. Specimens 3 (USNM 11707).

DESCRIPTION.—The 24 specimens presented from the Tokyo Imperial University, in exchange, were examined. Animals less than 12 mm. in length, surface wholly encrusted with fine sand grains. Six plications on each side of branchial sac, of which the second is represented by a single longitudinal vessel. Inner longitudinal vessels are arranged (D=dorsal, V=ventral):

10 mm. long specimen

Left	D	0	(9)	0	(1)	0	(8)	0	(6)	0	(6)	0	(3)	0	V
Right	D	0	(10)	0	(1)	0	(8)	0	(7)	0	(6)	0	(3)	0	V

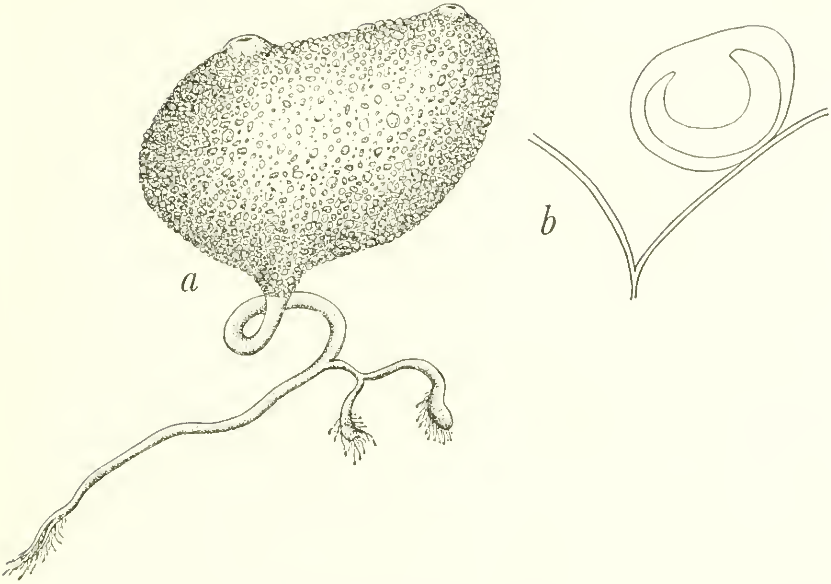

FIGURE 102.—*Hartmeyeria orientalis* Oka: *a*, right side of 10 mm. animal; *b*, dorsal tubercle of the same specimen.

12 mm. long specimen

Left	D	0	(11)	0	(1)	0	(10)	0	(8)	0	(5)	0	(4)	0	V
Right	D	0	(11)	0	(1)	0	(10)	0	(8)	0	(8)	0	(5)	0	V

Transverse vessels arranged 1 222 1 or 1 333 2 333 1 (numerals indicate orders of the thickness of vessels). Stigmata very elongated, being stretched between thick vessels of first order. Two infundibula under branchial fold in each interval between thick vessels of first order. Tip of each infundibulum divided into two apexes, thus four infundibular tops are found between each pair of thicker vessels. A kidney sac of very delicate membrane along ventral side of right gonad.

117. *Hartmeyeria chinensis*, new species

FIGURES 103, 104

HOLOTYPE.—USNM 11806: China; probably Amoy, received May 20, 1924, from S. F. Light, no further data.

PARATYPES.—USNM 11807, same data. 3 specimens.

DESCRIPTION.—Four specimens were examined from Chinese waters, two 23 mm. long individuals and two others respectively 17 mm. and 15 mm. long; one 23 mm. and the 17 mm. individuals were found attached side by side. Animals roughly triangular in shape (fig. 103*a*) with apex downward, fairly compressed laterally; encrusted densely with fine sand grains, grains covering dorsal siphonal area comparatively finer than those on ventral part of body. Test itself rather thick, reaches 1 mm. in larger individuals. Both apertures 4-lobed, sessile, and open on a slightly elevated dorsal ridge, being 8 mm. apart in a 23 mm. long individual (fig. 103*b*). No rooty protuberance (rhizom) found on present specimens. About 30 (29–32 in examined specimens) rather thick transverse muscles on each of anterior and posterior one-third of body, a number of fine transverse muscles cover dorsal side of body between both apertures and extend ventrally near middle of body, being interrupted once or twice on their way (fig. 103*c*). Longitudinal muscles covering dorsal half of body are beneath transverse musculature; about 30 on posterior half converge at atrial aperture, and about 25 anterior ones gather at branchial aperture. Around both apertures, longitudinal muscles run outside siphonal sphinctors. A small mantle prominence, somewhat cup-shaped in examined specimens, at ventral apex of body, approximately at level of one-third the body length from posterior end of body. Evidently this is homologous with that found at base of rhizom in *Hartmeyeria orientalis* Oka. Spinules on inner surface of siphons are peculiar in shape, being trifid at tip (figs. 104*a-c*). Those on the proximal part of the siphon are all laid nearly horizontally, 38–50μ in length in examined specimens; those from distal part somewhat like hemispherical elevations on surface, each ending in three fine spinules, about 36μ in height from base to tip of spinules.

In branchial sac tentacles 28–33, arranged in order: large-small-large or large-small-medium-small-large; branched very complicatedly, branches in three orders. Ciliated groove (figs. 103*g*, *h*) U-shaped, with both horns usually curled in or sometimes curled out. Six folds on each side of branchial sac, second fold rudimentary and represented by only a single longitudinal vessel. Inner longitudinal vessels arranged (D=dorsal, V=ventral):

15 mm. long individual

Left	D	0	(13)	0	(1)	0	(11)	0	(11)	0	(9)	0	(8)	0	V
Right	D	0	(14)	0	(1)	0	(12)	0	(11)	0	(10)	0	(9)	0	V

23 mm. long individual

Left	D	0	(15)	0	(1)	0	(13)	0	(12)	0	(12)	0	(9)	0	V
Right	D	0	(16)	0	(1)	0	(12)	0	(12)	0	(11)	0	(10)	0	V

Transverse vessels arranged: 1 333 2 333 1 or 1 4 3 4 2 4 3 4 1 (numerals indicate order of thickness of vessels). Extremely fine parastigmatic vessels at some places. Four infundibula between each pair of thicker vessels of first order, namely two between vessels of first and second orders. Tip of each infundibulum divided into two apexes. Stigmata elongated and generally extending between vessels of first and second orders, although often interrupted irregularly and complicatedly. Dorsal lamina plain membrane.

Liver consists of a longitudinally plicated anterior lobe and a posterior half consisting of many oval lobules of olive green, each with

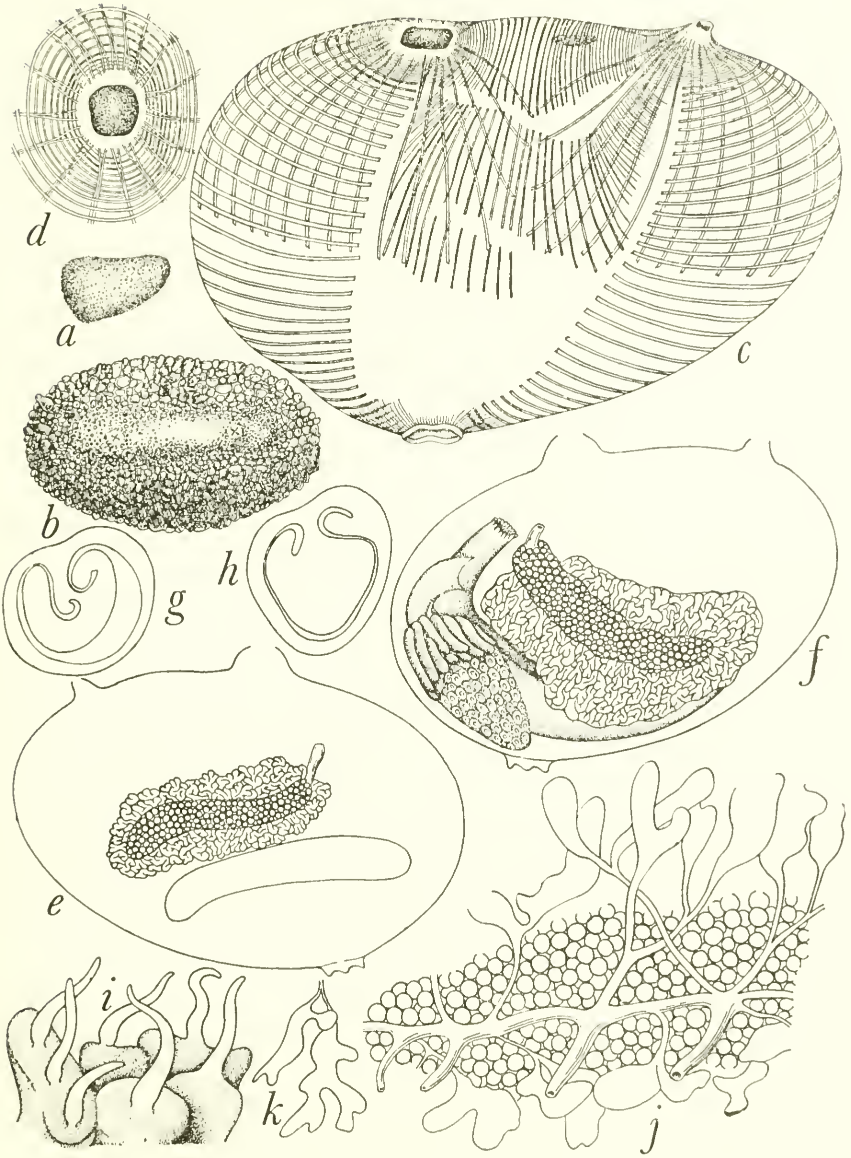

FIGURE 103.—*Hartmeyeria chinensis*, new species: *a*, entire animal; *b*, dorsal siphonal area of a specimen; *c*, right side of the mantle body; *d*, area of atrial aperture, showing arrangement of siphonal muscles; *e*, right half of mantle body, inside, *f*, left half of same; *g*, *h*, ciliated grooves; *i*, part of posterior half of liver, highly magnified; *j*, part of gonad showing four male genital pores, free surface; *k*, testicular follicles.

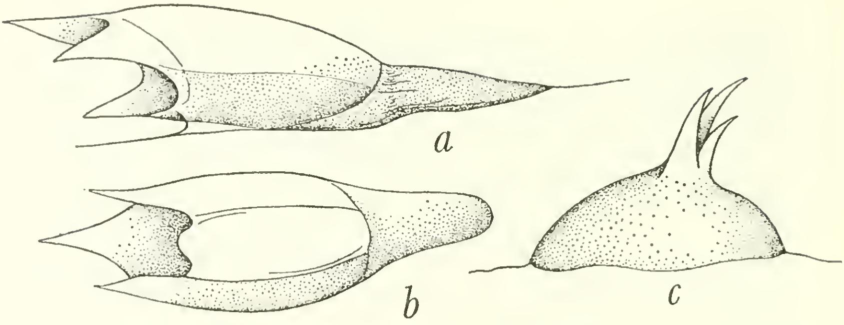

Figure 104.—*Hartmeyeria chinensis*, new species: *a*, *b*, lateral and undersides of the spinule from the inner surface of basal portion of siphons, highly magnified; *c*, spinule from the inner surface of distal part of siphons, highly magnified.

one to three whitish finger-shaped protuberances (fig. 103*i*). Margin of anus clearly cut into 16–20 lobules. Left gonad located obliquely across dorsal branch of intestinal loop, while right one situated along dorsal margin of renal sac, which is fairly elongated and extremely thin-walled. Openings of vas deferens rather numerous, 10 on the right, 11 on the left gonad in the 23 mm. long individual examined (fig. 103*j*).

Remarks.—It is uncertain whether the absence of rhizom is a natural characteristic or a result of somewhat rough treatment under which the animals were collected. Superficially the present new species closely resembles *H. orientalis* Oka from Japanese waters, but they differ distinctly in arrangement of muscles and in the appearance of the liver, anal margin, and spinules on the inner surfaces of siphons.

Class Appendicularia: Family Oikopleuridae

118. *Oikopleura (Coecaria) longicauda* (Vogt)

MATERIAL EXAMINED

Japan: 20 mi. SW. of Nagasaki. *Albatross* sta. 4889. Two specimens (USNM 11753) with *O.* (*C*) *fusiformis* Fol.

119. *Oikopleura (Coecaria) fusiformis* Fol

MATERIAL EXAMINED

Japan: 20 mi. SW. of Nagasaki. *Albatross* sta. 4889. One specimen (USNM 11753) with *O.* (*C*) *longicauda* (Vogt).

Class Thaliacea: Family Doliolidae

120. *Doliolum denticulatum* Quoy & Gaimard

MATERIAL EXAMINED

Japan: Suruga Gulf, off Ose Saki. *Albatross* sta. 5064. Ten specimens (USNM 11714).

North Pacific: 35°03′30″ N. 129°05′00″ W. *Albatross* sta. H–2708, surface sta. 64. One specimen (USNM 11713).

North Atlantic: 40°03′00″ N., 69°57′00″ W. *Albatross* sta. 2247. One specimen (USNM 11716).—39°26′00″ N., 68°03′30″ W. *Albatross* sta. 2569. One specimen (USNM 11715).

121. *Doliolum nationalis* Borgert

MATERIAL EXAMINED

Gulf of Mexico: Off west coast of Florida; *Grampus* townet sta. 9. Nine specimens (USNM 11723).

North Pacific: 35°03′30″ N., 129°05′00″ W.; surface; *Albatross* sta. H–2708. Two specimens (USNM 11712).

122. *Dolioletta gegenbauri* (Uljanin)

MATERIAL EXAMINED

Gulf of Mexico: Off west coast of Florida; *Grampus* townet sta. 9. 19 specimens (USNM 11724) (old oozooid or Amme=nurse).

Eastern Pacific: 39°18′ N., 123°58′ W.; surface; 800 fathoms to surface; *Albatross* sta. 4757. One specimen (USNM 11727).—0°36′00″ N., 82°45′00″ W.; surface to 1,740 fathoms; *Albatross* sta. H–2627. Ten specimens (USNM 11719).—12°34′00″ N., 97°21′00″ W.; *Albatross*, between 1890 and 1899, date illegible. One specimen (USNM 11728).

Gulf of California: Off Guaymas, Mexico; surface to 500 fathoms; *Albatross*, between 1890 and 1899, date illegible. 12 specimens (USNM 11720).

Gulf of Mexico: Off west coast of Florida; *Grampus* townet sta. 9. Two specimens (USNM 11725).

Remarks.—The eurymyonic, amphiclinous, and prozonal appearance, with myoplane 3–3½, of the foregoing specimens leads to the conclusion that they probably belong to *D. gegenbauri.* Among them, two groups are discernible: one with body muscles III and IV broader than the others; the other with only body muscle III broader than the others.

123. *Dolioletta gegenbauri tritonis* (Herdman)

MATERIAL EXAMINED

Eastern Pacific: 0°36′00″ N., 82°45′00″ W.; surface to 1,740 fathoms; *Albatross* sta. H–2627. Eight specimens (USNM 11718).

North Pacific: 34°56′30″ N., 129°20′00″ W.; surface; *Albatross* sta. H–2709. Eight specimens (USNM 11721).

North Atlantic: 37°40′30″ N., 70°37′30″ W.; *Albatross* sta. 2098. One phorozooid (USNM 11717).

124. *Doliolina intermedium* (Neumann)

MATERIAL EXAMINED

North Pacific: 34°56′30″ N., 129°20′00″ W.; surface; *Albatross* sta. H–2709. Two specimens (USNM 11722) (old oozooid or Amme=nurse).

Remarks.—Distinctly aclinous appearance of body muscles of the foregoing specimens attributes them to *D. intermedium.* The breadth of body muscles in these specimens is seemingly stenomyonic.

Family Salpidae

125. *Salpa maxima* var. *tuberculata* Metcalf

Figure 105*a*

Salpa maxima, variety *tuberculata* Metcalf, 1918, p. 87, fig. 72.

MATERIAL EXAMINED

PHILIPPINE ISLANDS: Jolo Island; anchorage. *Albatross* Philippine Expedition, March 5, 1908. 20 specimens collected by electric light at night (USNM 11739).

REMARKS.—Specimens up to 52 mm. in length, including anterior and posterior processes. Test considerably thick. Nucleus situated posterior to group of body muscles, enclosed in the roundish mass of very thick test. A pair of papillated thickenings on test just in front of atrial aperture.

126. *Salpa cylindrica* Cuvier

MATERIAL EXAMINED

PHILIPPINE ISLANDS: Luzon, east coast, off Legaspi Light; *Albatross* sta. 5456. One specimen, an 18 mm. long solitary form (USNM 11752).

127. *Iasis zonaria* (Pallas)

MATERIAL EXAMINED

PHILIPPINE ISLANDS: Marinduque Island; off outer Tayabas Light; *Albatross* sta. 5370. A single aggregate form (USNM 11751).

128. *Metcalfina hexagona* (Quoy & Gaimard)

PHILIPPINE ISLANDS: Northern Cebu, off Capitancillo Island; surface; *Albatross* sta. 5195. One aggregate form 48 mm. in length (USNM 11730).—Balayan Bay; *Albatross* sta. 5363. Seven aggregate forms (USNM 11740).

SOUTH PACIFIC: 10°15′ S., 95°41′ W.; 800 fath. to surface; *Albatross* sta. 4709. Five solitary forms (USNM 11785).

129. *Thalia democratica* var. *orientalis* Tokioka

Thalia democratica var. *orientalis* Tokioka, 1937, p. 226, fig. 1; pl. 14, figs. 2–3.—Bernard, 1958, p. 218, fig. 7.

Thalia democratica f. *orientalis* Sewell, 1953, p. 33, fig. 9B.

MATERIAL EXAMINED

PHILIPPINE ISLANDS: Northern Cebu; off Capitancillo Island; surface; *Albatross* sta. 5195. Aggregate forms 76, 13 solitary forms, and 1 embryo (USNM 11729).—Between Bohol and Leyte; 100 fath.; *Albatross* sta. 5233. One solitary form (USNM 11750).

Class Pyrosomata: Family Pyrosomidae

130. *Pyrosoma agassizi* Ritter & Byxbee

FIGURE 105*b–d*

Pyrosoma agassizi Ritter & Byxbee, 1905, p. 201.—Metcalf & Hopkins, 1919, p. 215, pls. 16–18; pl. 33, fig. 42.

MATERIAL EXAMINED

JAPAN: Honshu, off Manazuru Zaki; *Albatross* sta. 3698. One colony 46 mm. in length (USNM 11736).

REMARKS.—A single 46 mm. long colony dredged from 153 fathoms was found in quite an unsatisfactory state. However arrangement of ridges near closed end of colony is seen quite clearly in range of about 7 mm. from end. No prominences around aperture of colony.

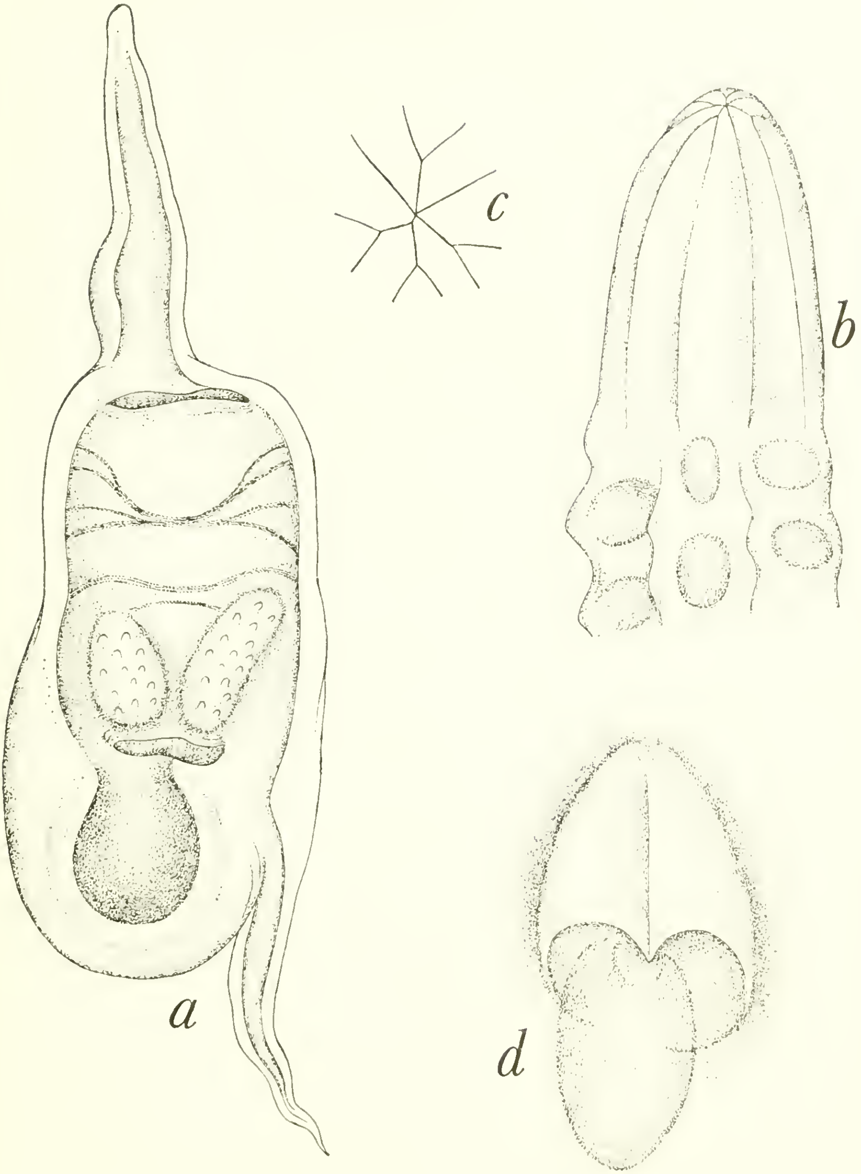

Figure 105.—*a*, *Salpa maxima* var. *tuberculata* Metcalf, dorsal side of an aggregated form from Philippine waters. *b–d*, *Pyrosoma agassizi* Ritter & Byxbee: *b*, closed end of colony; *c*, top view of closed end of colony; *d*, conical prominence on the colony surface.

Body muscle found on lateral side of branchial sac. From 26–35 stigmata arranged obliquely from anteroventral to posterodorsal side, 15–16 branchial bars or inner longitudinal vessels were counted on zooid with 26 stigmata. Dorsal languets about five. All these features fall in the range of the intraspecific variation in *Pyrosoma agassizi*, and most probably this is a colony in which the four characteristic prominences around the aperture of the colony were missing or torn off during dredging.

Literature Cited

ALDER, J., and HANCOCK, A.

1848. Additions to the mollusca of Northumberland and Durham. Tunicata. Trans. Tyneside Field Club, vol. 1, pp. 195–207.

ÄRNBÄCK-CHRISTIE-LINDE, A.

1925. Contributions to the tunicate fauna of Norway with notes on *Polycitor giganteus* Sluiter. Ark. Zool., vol. 18A, no. 1, 22 pp., 1 pl.

1935. A notable case of relation in *Perophora*. Ark. Zool., vol. 28B, no. 9, 6 pp., 3 text-figs.

1950. Ascidiacea. Part II. Further Zool. Res. Swedish Antarc. Exped. 1901–1903, vol. 4, no. 4, 41 pp., 9 text-figs., 6 pls.

BERNARD, M.

1958. Systématique et distribution saisonnière des tuniciers pélagiques d'Alger. Comm. Intern. Expl. Sci. Médit. Rapp. Proc.-Verb. Réunions, vol. 14 (n.s.), pp. 211–231, 15 text-figs.

BERRILL, N. J.

1932. Ascidians of the Bermudas. Biol. Bull., vol. 62, pp. 77–88, figs. 1–5.

1940. The development of a colonial organism: *Symplegma viride*. Biol. Bull., vol. 79, pp. 272–281, text-figs. 1–5.

BORGERT, A. H. C.

1894. Die Thaliacea der Plankton-Expedition. C. Vertheilung der Doliolen. Ergebn. Plankton-Exped. Humboldt-Stiftung, 2, E, a, C, pp. 1–66, pls. 5–8.

BREWIN, B. I.

1946. Ascidians in the vicinity of the Portobello Marine Biological Station, Otago Harbour. Trans. Roy. Soc. New Zealand, vol. 76, part 2, pp. 87–131, 19 text-figs., pls. 2–5.

1948. Ascidians of the Hauraki Gulf. Part I. Trans. Roy. Soc. New Zealand, vol. 77, part 1, pp. 115–138, 9 text-figs., pl. 9.

1950. Ascidians of New Zealand. Part V. Ascidians from the east coast of Great Barrier Islands. Trans. Roy. Soc. New Zealand, vol. 78, parts 2–3, pp. 354–362, 7 text-figs.

1952. Ascidians of New Zealand. Part VIII. Ascidians of the East Cape region. Trans. Roy. Soc. New Zealand, vol. 80, part 2, pp. 187–195, 3 text-figs., pl. 37.

1958. Ascidians of New Zealand. Part XI. Ascidians of the Stewart Island region. Trans. Roy. Soc. New Zealand, vol. 85, part 3, pp. 439–453, 3 text-figs.

CHIN, T. G.

1934. A preliminary report on Amoy Tunicata. Lingnan Sci. Journ., vol. 13, no. 3, pp. 487–491, pls. 53–54.

CUVIER, G.

1804. Mémoire sur les Thalides (*Thalia* Browne) et sur les Biphores (*Salpa* Forskål). Ann. Mus. Hist. Nat., vol. 4, pp. 360–382, pl. 68.

DRASCHE, R. VON

1884. Ueber einige neue und weniger bekannte aussereuropäische einfache Ascidien. Denkschr. Akad. Wiss. Wien., vol. 48, pp. 369–386, pls. 1–8.

FOL, M. H.

1872. Études sur les appendiculaires du détroit de Messine. Mém. Soc. Phys. Hist. Nat. Genéve, vol. 21, part 2, pp. 445–499, 11 pls.

GARSTANG, W.

1933. Report on the Tunicata. Part I. Doliolida. British Antarctic ("Terra Nova") Exped., 1910, Zool., vol. 4, no. 6, pp. 195–251, 8 text-figs.

GOTTSCHALDT, R.

1898. Synascidien von Ternate. Abh. Senckenberg. Naturf. Gesell., vol. 24, no. 1, pp. 641–660, pls. 35–36.

HARTMEYER, R.

1905. Ascidien von Mauritius. Zool. Jahrb., Syst., vol. 8, suppl., pp. 383–406, 3 text-figs., pl. 13.

1906. Ein Beitrag zur Kenntnis der japanischen Ascidienfauna. Zool. Anz., vol. 31, pp. 1–30, text-figs. 1–12.

1909–11. Ascidien. *In* Bronn. Klass. Ord. Tier-Reichs, vol. 3, suppl., pp. 1281–1773.

1912. Die Ascidien der deutschen Tiefsee-Expedition. Wiss. Ergebn. Deutsch. Tiefsee-Exped., vol. 16, pp. 225–392, text-figs. 1–10, pls. 37–44. 2 maps.

1919. Ascidien. *In* Results of Dr. E. Mjöberg's Swedish Scientific Expeditions to Australia, 1910–13. K. Svenska Vetenskaps-Akad. Handl., vol. 60, no. 4, 150 pp., 25 text-figs., 2 pls.

1923–1924. Ascidiacea. *In* Danish *Ingolf*-Expedition, vol. 2, part 6, 368 pp., 35 text-figs., 1 pl., 1 map; part 7, 278 pp., 45 text-figs., 1 map.

HARTMEYER, R., and MICHAELSEN, W.

1928. Ascidiae Diktyobranchiae und Ptychobranchiae. Fauna Südwest-Australiens, vol. 5, no. 6, pp. 251–460, text-figs. 1–61.

HASTINGS, A. B.

1931. Tunicata. Great Barrier Reef Exped., Sci. Rep., vol. 4, no. 3, pp. 69–110, text-figs. 1–17, pls. 1–3.

HELLER, C.

1878. Beiträge zur nähern Kenntniss der Tunicaten. Sitzber. Akad. Wiss. Wien, vol. 77, no. 1, pp. 83–110, pls. 1–6.

HERDMAN, W. A.

1880–81. Preliminary report on the Tunicata of the *Challenger* Expedition, part 1 (1880), Ascidiadae. Proc. Roy. Soc. Edinburgh, vol. 10, pp. 458–472; part 2 (1880), vol. 10, pp. 714–726; part 3 (1881), Cynthiadae, vol. 11, pp. 52–88, 1 text-fig.; part 4 (1881), Molgulidae, vol. 11, pp. 233–240.

1882. Report on the Tunicata I. Ascidiae Simplices. Rep. *Challenger* Exped., Zool., vol. 6, part 17, 296 pp., 37 pls.

1886. Report on the Tunicata collected during the voyage of H.M.S. *Challenger* during the years 1873–1876. Part 2. Ascidiae Compositae. Rep. *Challenger* Exped., Zool., vol. 14, 432 pp., 15 text-figs., 49 pls.

1888. Report on the Tunicata collected during the voyage of H.M.S. *Challenger*, during the years 1873–1876. Part 3. Rep. *Challenger* Expedition, Zool., vol. 27, 163 pp., 11 pls.

1899. Descriptive catalogue of the Tunicata in the Australian Museum, Sydney, N.S.W. Liverpool, 139 pp., 45 pls.

1906. Report on the Tunicata. Ceylon Pearl Oyster Fisheries, suppl. Rep., vol. 39, pp. 295–348, pls. 1–9.

Huus, J.

1936. Ascidiologische Notizen. II. Ueber den Fund von *Styela atlantica* (Van Name) an der norwegischen Westküste mit Bemerkungen über die amphiatlantische Verbreitung einiger Ascidien. Bergens Mus. Årbok, 1936, Nat. Rekke, no. 5, pp. 1–18, text-figs. 1–8.

Kott, P.

1952. The ascidians of Australia. I. Stolidobranchiata Lahille and Phlebobranchiata Lahille. Australian Journ. Mar. Freshwater Res., vol. 3, no. 3, pp. 205–336, 183 text-figs.

Lesueur, C. A.

1823. Descriptions of several new species of Ascidia. Journ. Acad. Nat. Sci. Philadelphia, vol. 3, pp. 2–8, pls. 1–3.

Metcalf, M. M.

1918. The Salpidae collected by the United States Fisheries Steamer *Albatross*, in Philippine waters, during the years 1908 and 1909. U.S. Nat. Mus. Bull. 100, vol. 2, part 2, pp. 1–193, 150 text-figs., 14 pls.

Metcalf, M. M., and Hopkins, H. S.

1919. Pyrosoma.—A taxonomic study, based upon the collections of the United States Bureau of Fisheries and the United States National Museum. U.S. Nat. Mus. Bull. 100, vol. 2, part 3, pp. 195–275, 9 text-figs., pls. 15–36.

Michaelsen, W.

1904. Revision der compositen Styeliden oder Polyzoinen. Jahrb. Wiss. Anst., Hamburg, vol. 21, suppl. 2, pp. 1–124, 1 text-fig., pls. 1–2, 1 map.

1914. Ueber einige westafrikanische Ascidien. Zool. Anz., vol. 43, pp. 423–432.

1919. Zur Kenntnis der Didemniden. Abhandl. aus dem Gebiete der Naturwiss., herausg. vom Naturwiss. Verein in Hamburg, vol. 21, no. 1, pp. 1–44, 3 text-figs.

1921. Ascidien vom westlichen Indischen Ozean aus dem Reichsmuseum zu Stockholm. Ark. Zool., vol. 13, no. 23, 25 pp., 1 pl.

1922. Ascidiae Ptychobranchiae und Diktyobranchiae von Neuseeland und den Chatham Inseln. Vid. Meddel. Dansk Naturh. Foren., vol. 73, pp. 359–498, text-figs. 1–35.

1923. Neue und altbekannte Ascidien aus dem Reichsmuseum zu Stockholm. Mitt. Zool. Mus. Hamburg, vol. 40, pp. 1–60, 12 text-figs.

1924. Ascidiae Krikobranchiae von Neuseeland, den Chatham und den Auckland Inseln. Vid. Meddel. Dansk Naturh. Foren., vol. 77, pp. 263–434, 30 text-figs.

Millar, R. H.

1953. On a collection of ascidians from the Gold Coast. Proc. Zool. Soc. London, vol. 123, part 2, pp. 277–325, 26 text-figs.

1955. On a collection of ascidians from South Africa. Proc. Zool. Soc. London, vol. 125, part 1, pp. 169–221, 40 text-figs.

1956. Ascidians from Mozambique, East Africa. Ann. Mag. Nat. Hist., ser. 12, vol. 9, pp. 913–932, 15 text-figs.

1959. Ascidiacea. Galathea Report, vol. 1, pp. 189–209, 20 text-figs., 1 pl.

NEUMANN, G.
1906. Doliolum. Wiss. Ergebn. Deutsch. Tiefsee-Exped., vol. 12, part 2, pp. 93–243, pls. 11–25.

OKA, A.
1892. Die periodische Regeneration der oberen Körperhälfte bei den Diplosomiden. Biol. Centralblatt, vol. 12, no. 9, pp. 265–268, 1 text-fig.
1906a. *Aphanibranchion*, eine neue Synascidien-Gattung aus Japan. Annot. Zool. Japon., vol. 5, part 5, pp. 253–265, pl. 13.
1906b. Notizen über japanische Ascidien. I. Annot. Zool. Japon, vol. 6, part 1, pp. 37–52.
1914. Notizen über japanische Ascidien. II. Annot. Zool. Japon, vol. 8, part 3, pp. 443–458, text-figs. 1–16.
1927. Zur Kenntnis der japanischen Botryllidae (Vorläufige Mitteilung). Proc. Imp. Acad., vol. 3, no. 9, pp. 607–609.
1928a. Ueber einen neuen *Culcolus* aus dem westlichen Pazifik. Proc. Imp. Acad., vol. 4, no. 5, pp. 226–228, text-figs. A and B.
1928b. Ueber eine merkwürdige *Botryllus*-Art, *B. primigenus* nov. sp. Proc. Imp. Acad., vol. 4, no. 6, pp. 303–305, text-figs. A and B.
1929. Ueber eine neue *Hartmeyeria* aus Japan. Proc. Imp. Acad., vol. 5, no. 8, pp. 351–353, text-figs. A–C.
1930. Ueber eine scheibenförmige *Styela*-Art aus Nord-Japan. Proc. Imp. Acad., vol. 6, no. 10, pp. 427–430, text-figs. A–C.
1931a. Ueber eine neue species von *Ecteinascidia* aus Formosa. Proc. Imp. Acad., vol. 7, pp. 173–175, 3 text-figs.
1931b. Ueber eine nördliche Varietät von *Corella japonica*. Proc. Imp. Acad., vol. 7, pp. 198–200.
1931c. Ueber eine neue Art von der merkwüldigen Synascidien-Gattung *Hypurgon*. Proc. Imp. Acad., vol. 7, pp. 287–290, 1 text-fig.
1934. Ueber *Molstyela*, eine merkwürdige neue Gattung von einfachen Ascidien. Proc. Imp. Acad., vol. 10, no. 5, pp. 292–294, text-figs. A–C.
1935. Report of the Biological Survey of Mutsu Bay 28. Ascidiae Simplices. Sci. Rep. Tôhoku Imp. Univ., vol. 10, no. 3, pp. 427–466, 35 text-figs.

OKA, A., and WILLEY, A.
1892. On a new genus of Synascidians from Japan. Quart. Journ. Micr. Sci., vol. 33, part 2, pp. 313–324, pls. 17–18.

PALLAS, P. S.
1774. Spicilegia zoologica. Vol. 1, no. 10, pp. 17–18, pls. 1 and 4.
1787. Marina varia nova et rariora. Nova Acta Acad. Petropolis, vol. 2, pp. 229–249, pls. 5–7.

PIZON, A.
1908. Ascidies d'Amboine. Rev. Suisse Zool., vol. 16, pp. 195–240, pls. 9–14.

QUOY, J., and GAIMARD, P.
1834. Voyage . . . de l'*Astrolabe* . . ., Zoologie, vol. 3, 952 pp., 8 pls.

REDIKORZEV, V.
1927. Zehn neue Ascidien aus dem fernen Osten. Zool. Jahrb., Syst., vol. 53, pp. 373–404, text-figs. 1–20.

RITTER, W. E., and BYXBEE, E. S.
1905. The pelagic Tunicata. Mem. Mus. Comp. Zool., vol. 26, no. 5, pp. 195–214, pls. 1–2.

RITTER, W. E., and FORSYTH, R. A.
1917. Ascidians of the littoral zone of southern California. Univ. California Publ. Zool., vol. 16, pp. 439–512, pls. 38–46.

SAVIGNY, J. C.

1816. Memoires sur les animaux sans vertebres. Part 2, fasc. 1, Paris, 240 pp., 24 pls.

SEWELL, R. B. S.

1953. The pelagic Tunicata. John Murray Exped., 1933–34, Sci. Rep., vol. 10, no. 1, pp. 1–90, 32 text-figs., 1 pl.

SLUITER, C. P.

1885. Ueber einige einfachen Ascidien von der Insel Billiton. Natuurk. Tijdschr. Nederl.-Indië, vol. 45, pp. 160–232, pls. 1–9.

1890. Die Evertebraten aus der Sammlung des Kgl. naturw. Vereins in Nederl. Ind. in Batavia. Zugleich eine Skizze der Fauna des Java Meeres mit Beschreibung der neuen Arten Ascidiae Simplices. Natuurk. Tijdschr. Nederl.-Indië, vol. 50, pp. 329–348, pls. 1–2.

1895. Tunicaten. *In* Semon, R., Zoologische Forschungsreisen in Australien und den malayischen Archipel. Denkschr. Gesell., vol. 8, pp. 163–186, pls. 6–10.

1900. Tunicaten aus dem Stillen Ozean. Zool. Jahrb., Syst., vol. 13, pp. 1–35, pls. 1–6.

1904. Die Tunicaten der *Siboga*-Expedition. I Abt. Die socialen und holosomen Ascidien. *Siboga*-Exped., Monogr. 56a, 126 pp., 15 pls.

1909. Die Tunicaten der *Siboga*-Expedition. II Abt. Die merosomen Ascidien. *Siboga*-Exped., Monogr. 56b, 112 pp., 2 text-figs., 8 pls.

1914. Ascidien von den Aru-Inseln. Abhandl. Senckenberg. Naturforsch. Gesell., vol. 35, no. 1, pp. 65–78, pls. 5–6.

1919. Ueber einige alte und neue Ascidien aus dem Zoologischen Museum von Amsterdam. Bijd. Dierk., Afl. 21, pp. 1–12, 1 pl.

STIMPSON, W.

1852. Several new ascidians from the coast of the United States. Proc. Boston Soc. Nat. Hist., vol. 4, pp. 228–232.

TOKIOKA, T.

1937. Notes on Salpas and Doliolums occurring on the Pacific coast of middle Japan. Annot. Zool. Japon., vol. 16, no. 3, pp. 219–232, 1 text-fig., pls. 13–14.

1942. Ascidians found on the Mangrove trees in Iwayama Bay, Palao. Palao Trop. Biol. Stat. Studies, vol. 2, no. 3, pp. 497–506, 2 text-figs., pl. 4.

1949a. Contributions to Japanese ascidian fauna. I. Ascidians collected by Prof. Miyadi and Mr. Masui during the bottom survey 1939–40. Publ. Seto Mar. Biol. Lab., vol. 1, no. 1, pp. 1–17, pls. 1–7.

1949b. Contributions to Japanese ascidian fauna. II. Notes on some ascidians collected chiefly along the coast of Kii Peninsula. Publ. Seto Mar. Biol. Lab., vol. 1, no. 2, pp. 39–64, text-figs. 1–16, pl. 8.

1950. Ascidians from the Palao Islands. I. Publ. Seto Mar. Biol. Lab., vol. 1, no. 3, pp. 115–150, 23 text-figs., pls. 9–10.

1951a. The fauna of Akkeshi Bay 18. Ascidia. Publ. Akkeshi Mar. Biol. Stat., no. 1, 22 pp., 16 text-figs., 2 pls.

1951b. Contributions to Japanese ascidian fauna. IV. Notes on some ascidians collected in Ôsaka Bay (1). Publ. Seto Mar. Biol., Lab., vol. 1, no. 4, pp. 169–182, 8 text-figs., pl. 11.

1952. Ascidians collected by Messrs. Renzi Wada and Seizi Wada from the pearl oyster bed in the Arafura Sea in 1940. Publ. Seto Mar. Biol., Lab., vol. 2, no. 2, pp. 91–142, 29 text-figs.

1953a. Ascidians of Sagami Bay. Tokyo, 315 pp., 25 text-figs., 80 pls.

1953b. Contributions to Japanese ascidian fauna. V. Ascidians collected near the Marine Biological Laboratory of Hiroshima University in the Inland Sea (1). Publ. Seto Mar. Biol. Lab., vol. 3, no. 1, pp. 1–25, 16 text-figs.

1953c. Contributions to Japanese ascidian fauna. VI. Simple ascidians of the Museum of Hukui. Publ. Seto Mar. Biol. Lab., vol. 3, no. 1, pp. 27–32, 3 text-figs., 1 pl.

1954a. Cantributions to Japanese ascidian fauna. VII. Invertebrate fauna of the intertidal zone of the Tokara Islands. VII. Ascidians. Publ. Seto Mar. Biol. Lab.. vol. 3, no. 3, pp. 239–264, 2 text-figs., pls. 18–37.

1954b. Contributions to Japanese ascidian fauna. X. Notes on some ascidians collected in Ôsaka Bay (2). Publ. Seto Mar. Biol. Lab., vol. 4, no. 1, pp. 75–98, 7 text-figs., pls. 5–8.

1955a. Contributions to Japanese ascidian fauna. XI. Sporadic memoranda (2). Publ. Seto Mar. Biol. Lab., vol. 4, nos. 2–3, pp. 205–218, 5 text-figs., pls. 11–14.

1955b. Ascidians from the Palao Islands II. Publ. Seto Mar. Biol. Lab., vol. 5, no. 1, pp. 43–57, 4 text-figs., 6 pls.

1955c. Revision of ascidians described and illustrated in Japanese "Dôbutu Zukan." Zool. Mag. Tokyo, vol. 64, no. 1, pp. 20–23 (in Japanese, with English summary).

1959a. Contributions to Japanese ascidian fauna. XIII. Sporadic memoranda (4). Publ. Seto Mar. Biol. Lab., vol. 7, no. 2, pp. 223–236, 1 text-fig., pls. 13–18.

1959b. Contributions to Japanese ascidian fauna. XV. Sporadic memorandum (6) *Styela clava* var. *symmetrica* nov., a new pedunculate styelid from the Inland Sea. Publ. Seto Mar. Biol. Lab., vol. 7, no. 3, pp. 457–463, 1 text-fig.

1960a. Contributions to Japanese ascidian fauna. XVI. On some ascidians from the northern waters of Japan and the neighbouring subarctic waters. Publ. Seto Mar. Biol. Lab., vol. 8, no. 1, pp. 191–204, pls. 20–25.

1960b. Contributions to Japanese ascidian fauna. XVII. Ascidians found in the benthonic samples dredged in the Ariake Sea, 1957–58. Publ. Seto Mar. Biol. Lab., vol. 8, no. 1, pp. 205–221, pls. 26–30, 2 text-figs.

1961. Ascidians collected during the Melanesia Expedition of the Ôsaka Museum of Natural History. I. Ascidians presented by Dr. R. L. A. Catala of the Aquarium of Noumea. Publ. Seto Mar. Biol. Lab., vol. 9, no. 1, pp. 103–138, pl. 5, 15 text-figs.

TRAUSTEDT, M. P. A.

1885. Ascidiae simplices fra det stille Hav. Vidensk. Meddel. Dansk Naturh. Foren., ann. 1884, pp. 1–60, pls. 1–4.

TRAUSTEDT, M. P. A., and WELTNER, W.

1894. Bericht über die von Herrn Dr. Sander gesammelten Tunicaten. Arch. Naturg., vol. 60, part 1, pp. 10–14, pl. 2.

ULJANIN, B. N.

1884. Die Arten der Gattung *Doliolum* im Golfe von Neapel un den angrenzenden Meeresabschnitten. Fauna Flora Golfes von Neapel., monogr. 10, 140 pp., 12 pls.

VAN NAME, W. G.

1902. The ascidians of the Bermuda Islands. Trans. Connecticut Acad. Sci., vol. 11, pp. 325–412, pls. 46–64.

1912. Simple ascidians of the coast of New England and neighboring British Provinces. Proc. Boston Soc. Nat. Hist., vol. 34, pp. 439–619, text-figs. 1–43, pls. 43–73.

1918. Ascidians of the Philippines and adjacent waters. U.S. Nat. Mus. Bull. 100, vol. 1, part 2, pp. 49–111, 115 text-figs., pls. 23–33.

1921. Ascidians of the West Indian region and southeastern United States. Bull. American Mus. Nat. Hist., vol. 44, pp. 283–494, text-figs. 1–159.

1924. Ascidians from Curaçao. Bijd. Dierk., vol. 23, pp. 23–32, text-figs. 1–7.

1930. The ascidians of Porto Rico and the Virgin Islands, Sci. Surv. Porto Rico and Virgin Islands, New York Acad. Sci., vol. 10, pp. 401–512, text-figs. 1–73, pls. 5–8.

1945. The North and South American ascidians. Bull. American Mus. Nat. Hist., vol. 84, pp. 1–476, 31 pls., 327 text-figs.

VOGT, C.

1854. Recherches sur les animaux inférieurs de la Méditerranée. Deuxième Mémoire. Sur les tuniciers mageants de la mer de Nice. Mém. Inst. Genéve, vol. 2, part 3, pp. 1–102, pls. 5–10.

Index

(Names of new genera and species in *italics;* page numbers of principal accounts in *italics*)

acoroids, Enhalus, 2, 3, 68, 69
aequali-siphonis, Amaroucium, 56, 58
  Sigillinaria, 56
aequalisiphonis, Ritterella, 9, 14, 17, *56*, 57 (fig.)
agassizi, Pyrosoma, 9, 17, *230*, 231 (fig.)
albatrossae, Eudistoma, 10, 15, 17, *124*, 125 (fig.)
albopunctatum, Didemnum, 89, 92
alcyonarian, 6, 74
Amaroucium, 58
  aequali-siphonis, 56, 58
  californicum, 35, 40
  coei, 58
  constellatum, 8, 14, 17, *30*
  constrictum, 4, 14, 19, 32, *43*, 44 (fig.), 45
  crateriferum, 4, 5, 14, 19, *40*, 41 (fig.), 42 (fig.)
  distomoides, 28
  dubium, 56
  fragile, 29, 30, 58
  glabrum, 9, 10, 11, 14, 17, *30*, 31 (fig.), 43, 44 (fig.), 45
  monotonicum, 33, 35
  sp. aff. monotonicum, 5, 14, 19, *33*, 34 (fig.)
  multiplicatum, 5, 8, 14, 19, 20, *35*, 36, 37 (fig.), 38 (fig.), 39, 40, 43
  sp. aff. multiplicatum, 35, 39
  pliciferum, 10, 14, 20, *32*, 33 (fig.)
  sagamiense, 36, 40, 43
  solidum, 56
  spitzbergense, 26
  variable (sic), 45, 47
Amouroucium constellatum, 30
  glabrum, 30
amoyense, Aplidiopsis, 8, 14, 18, *45*, 46 (fig.)
amplum, Eudistoma, 4, 15, 19, 118 (fig.), *121*
amplus, Eudistoma, 121
  Polycitor, 112, 121
angolanum, Eudistoma, 7, 8, 15, 19, 20, 80, *112*, 113 (fig.), 117
  Eudistoma sp. aff., 3, 5, 15, 19, *115*, 116 (fig.)
angolanus, Polycitor paesslerioides var., 112
annulatus, Culeolus, 221
antillensis, Dromidia, 108
apersum, Didemnum (Didemnum), 70, 73, 74
aperta, Ascidia, 13, 15, 20, *143*, 144 (fig.)
Aphanibranchion japonicum, 133
Aplidiopsis *amoyense*, 8, 14, 18, *45*, 46 (fig.)
  tokaraensis, 47
Aplidium depressum, 24, 26
  sp. aff. depressum, 6, 14, 18, *24*, 25 (fig.)
  lobatum, 3, 5, 6, 7, 14, 18, 19, 20, *22*, 23 (fig.), 24
  sp. aff. lobatum, 14, 18, 23 (fig.), *24*
  multiplicatum, 35
  spitzbergense, 9, 14, 17, *26*, 27 (fig.)
  tremulum, 22, 24
  yezoense, 8, 14, 17, *28*, 29 (fig.)
Aplousobranchia, 14 (list), 22
Appendicularia, 16 (list), 228
arafurensis, Clavelina (Synclavella), 4, 5, 15, 19, *106*, 107 (fig.)
areolata, Cnemidocarpa, 5, 16, 19, *181* 182 (fig.)
  Styela, 181
areolatum, Didemnum, 80
asamusi, Corella japonica var., 8, 15, 17, *149* (fig.)
Ascidia, 139
  aperta, 13, 15, 20, *143*, 144 (fig.)
  aurantium, 219
  aurata, 169
  depressiuscula, 140
  gemmata, 5, 13, 15, 19, 20, *140*, 141 (fig.)
  longistriata, 146, 147
  minuta, 3, 15, 19, *142* (fig.)
  papillosa, 9, 15, 17, *145*, 146 (fig.)
  plicata, 190
  samea, 138
  sydneiensis samea, 11, 15, 18, *138*, 139 (fig.)
Ascidiacea, 14 (list), 22

Ascidiidae, 15 (list), 138
aspera, Pyura, 197
atlantica, Styela, 9, 16, 17, *191*, 192 (fig.)
    Styela (Botryorchis), 191
atlanticum, Tethyum, 191
aurantium, Ascidia, 219
    Halocynthia, 9, 16, 18, *219*
aurata, Ascidia, 169
    Pandocia, 169
    Polycarpa, 12, 16, 20, *169* (fig.)
australis, Microcosmus claudicans var., 207
    Stereoclavella, 106
bermudensis, Perophora, 136
Boltenia pachydermatina, 204
Botryllidae, 15 (list), 151
Botryllocarpa viridis, 164
Botrylloides, 36
    chevalense, 160
    diegensis, 160
    leachi, 160
    nigrum var. magnicoccum, 153
    purpureum, 156
    tyreum, 3, 16, 20, *156*, 157 (fig.)
    violaceum, 158
    violaceus, 3, 8, 16, 17, 20, *158*, 159 (fig.)
    violaceus *marginatus*, 3, 5, 16, 20, *160*, 161 (fig.)
botryllopsis, Diandrocarpa, 162
Botryllus communis, 151
    compositus, 12, 16, 18, *155*, 156 (fig.)
    magnicoccus, 8, 16, 18, *153*, 154 (fig.)
    primigenus, 5, 8, 15, 18, 19, *151*
    rufus, 153, 155
    tuberatus, 3, 7, 8, 15, 18, 20, *151*, 152 (fig.)
Botryorchis, subg., 191
brakenhielmi, Diandrocarpa, 162
    Symplegma viride, 162
caliciforme, Leptoclinum, 100, 101
californicum, Amaroucium, 35, 40
candidum, Didemnum (Didemnum), 3, 4, 5, 6, 7, 8, 12, 13, 14, 18, 19, 20, 21, *62*, 63 (fig.), 95, 110, 112
captiosa, Polycarpa, 4. 5, 16, 19, 20, *171*, 172 (fig.), 181
    Styela, 171
Caulerpa, 3, 68
ceylonica, Diandrocarpa brakenhielmi var., 162
Chelyosoma siboja, 9, 15, 17, *150* (fig.)
chevalense, Botrylloides, 160
chinensis, Cnemidocarpa, 8, 16, 18, *188*, 189 (fig.)
    Hartmeyeria, 8, 16, 18, *225*, 227 (fig.), 228 (fig.)
Ciallusia, 136
    longa, 11, 15, 18, *133*, 135 (fig.)
Ciona intestinalis, 133
Cionidae, 15 (list), 133
clava, Styela, 9, 11, 12, 16, 17, 18, *190* (fig.)
Clavelina, 108
    (Synclavella) arafurensis, 4, 5, 15, 19, *106*, 107 (fig.)
    coerulea, 104, 106
    fasciata, 104, 106
    fecunda, 5, 15, 19, *101*, 102, 103 (fig.), 106
    (Synclavella) gigantea, 12, 15, 21, *108*, 109 (fig.)
    (Podoclavella) meridionalis, 104
    molluccensis, 4, 5, 15, 19, 102, *104*, 105 (fig.), 108
    oblonga, 108
claviformis, Euherdmania, 60
Cnemidocarpa areolata, 5, 16, 19, *181*, 182 (fig.)
    chinensis, 8, 16, 18, *188*, 189 (fig.)
    fertilis, 9, 16, 17, *183* (fig.)
    fertilis molguloides, 191
    incubita, 5, 16, 19, *186*, 187 (fig.), 188 (fig.)
    irma, 181
    macrogastra, 9, 16, 17, *183* (fig.), 186
    personata, 13, 16, 21, *184*, 185 (fig.)
    valborg, 181
Cnemidocarpa, subg., 181
coalitus, Polycitor, 128
Coccaria, subg., 10, 16, 228
coei, Amaroucium, 58
coerulea, Clavelina, 104, 106
communis, Botryllus, 151
complanata, Cynthia, 206
compositus, Botryllus, 12, 16, 18, *155*, 156 (fig.)
connectens, Symplegma, 165
constellatum, Amaroucium, 8, 14, 17, *30*
    Amouroucium, 30
    Polyclinum, 3, 8, 10, 14, 17, 19, 20, *53*, 54 (fig.)
constrictum, Amaroucium, 4, 14, 19, 32, *43*, 44 (fig.), 45

coral, 2, 3, 4, 5, 6, 7, 8, 10, 12, 74, 92, 126
Corallinaceae, 77
Corella japonica, 9, 10, 15, 17, *148* (fig.)
japonica var. asamusi, 8, 15, 17, *149* (fig.)
coriacea, Cynthia, 195
Styela, 9, 16, 17, *195*, 196 (fig.)
crateriferum, Amaroucium, 4, 5, 14, 19, *40*, 41 (fig.), 42 (fig.)
cryptocarpa, Polycarpa, 4, 5, 7, 8, 13, 16, 20, 62, 63, 64, 72, 122, *173*, 174 (fig.), 176
Styela, 173
Culeolus, 220
annulatus, 221
easteri, 9, 16, 21, *220*, 221 (fig.)
gigas, 221
herdmani, 220
inversus, 221
moseleyi, 221
murrayi, 221
pyramidalis, 222
quadrata, 220
sluiteri, 222
suhmi, 222
thysanotus, 221
wyville-thomsoni, 222
curvigona, Pyura, 4, 16, 20, *199*, 200 (fig.), 201 (fig.)
curvus, Microcosmus, 4, 5, 13, 16, 19, 20, *215*, 217 (fig.), 218 (fig.)
Cyanophyceae, 88
cyclops, Trididemnum, 7, 8, 14, 20, *85*, 86 (fig.)
cylindrica, Holozoa, 131
Salpa, 11, 17, *230*
Cynthia complanata, 206
coriacea, 195
grandis, 206
lutea, 204
mirabilis, 205
Roretzi, 219
sacciformis, 197
sanderi, 197
vittata, 202
deerrata, Distoma, 124, 128
denticulatum, Doliolum, 9, 11, 12, 17, *228*
depressiuscula, Ascidia, 140
depressum, Aplidium, 24, 26
Aplidium sp. aff., 6, 14, 18, *24*, 25 (fig.)
Diandrocarpa botryllopsis, 162
brakenhielmi, 162
brakenhielmi var. ceylonica, 162
Diazona, 133
Diazonidae, 15 (list), 133
Didemnidae, 14 (list), 62
patella, 96
sulcatum, 96, 97
ternatanum, 77
Didemnopsis jolense, 82, 84, 85
globuliferum, 87
Didemnum, 77, 84, 89, 90, 91
albopunctatum, 89, 92
(Didemnum) apersum, 70, 73, 74
areolatum, 80
(Didemnum) candidum, 3, 4, 5, 6, 7, 8, 12, 13, 14, 18, 19, 20, 21, *62*, 63 (fig.), 110, 112
(Didemnum) dorotubu, 6, 8, 14, 18, 71, *74*, 75, 76 (fig.)
(Didemnum) fuscum, 74
(Leptoclinum) fuscum, 70
(Didemnum) gottschaldti, 97
grande, 65
(Didemnum) *macrospiculatum*, 7, 14, 20, *71* (fig.)
(Didemnum) misakiense, 10, 11, 14, 17, 18, *75*, 76 (fig.), 81
moseleyi, 90
(Didemnum) moseleyi, 3, 4, 5, 6, 7, 10, 11, 13, 14, 17, 18, 19, 20, 21, 63 (fig.), *65*, 66, 69, 70, 74
(Leptoclinum) moseleyi, 65
(Didemnum) moseleyi f. granulatum, 3, 4, 14, 19, 63 (fig.), *67*
(Didemnum) *nekozita*, 3, 5, 6, 14, 18, 19, *67*, 68, (fig.), 70
(Didemnum) patella, 96
(Didemnum) pulvinum, 97
recurvatum, 62
reticulatum, 89, 92
(Polysyncraton) sagamiana, 3, 14, 19, *78*, 79 (fig.)
savignii, 80
(Polysyncraton) semifuscum 7, 14, 20, *78*, 79 (fig.)
(Didemnum) *siphonale*, 9, 14, 17, *72*, 73 (fig.)
(Didemnum) *sphaericum*, 5, 14, 19, *70*, 71 (fig.)
(Leptoclinum) spongioides, 70
ternatanum, 65, 78
(Didemnum) ternatanum, 2, 3, 5, 6, 14, 18, 19, 33, 76 (fig.), *77*, 97

Didemnum, subg., 3, 4, 5, 6, 7, 9, 10, 11, 13, 14, 18, 19, 20, 21, 62, 63, 65, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 81, 84, 90, 96, 97
diegensis, Botrylloides, 160
digitata, Euherdmania, 4, 14, 19, *58*, 59 (fig.)
Diplosoma mitsukurii, 100
  virens, 98
  viride, 98
Diplosomoides fragile, 94
  molle, 95
Distaplia cylindrica f. typica, 13, 15, 21, *131*, 132 (fig.)
  mikropnoa, 4, 15, 19, *129*, 130 (fig.)
Distoma deerrata, 124, 128
  laysani, 119
distomoides, Amaroucium, 28
Dolioletta gegenbauri, 10, 11, 12, 17, *229*
  gegenbauri tritonis, 9, 12, 17, *229*
Doliolidae, 17 (list), 228
Doliolina intermedium, 12, 17, *229*
Doliolum denticulatum, 9, 11, 12, 17, *228*
  nationalis, 12, 17, *229*
dorotubu, Didemnum (Didemnum), 6, 8, 14, 18, 71, *74*, 75, 76 (fig.)
draschii, Microcosmus, 206
Dromidia antillensis, 108
  larraburei, 62
  undentata, 126
dubium, Amaroucium, 56
easteri, Culeolus, 9, 16, 21, *220*, 221 (fig.)
Echinoclinum, 94
  philippinense, 6, 14, 18, *93* (fig.)
  verrilli, 94
Echinogorgia, 75
Echinogorgia sp., 80
Ecteinascidia formosana, 136
  imperfecta, 4, 15, 19, *137* (fig.)
Enhalus, 3, 4
  acoroides, 2, 3, 68, 69
etheridgii, Styela, 184
Eudistoma, 124
  albatrossae, 10, 15, 17, *124*, 125 (fig.)
  amplum, 4, 15, 19, 118 (fig.), *121*
  amplus, 121
  angolanum, 7, 8, 15, 19, 20, 80, *112*, 113 (fig.), 117
  sp. aff. angolanum, 3, 5, 15, 19, *115*, 116 (fig.)
  laysani, 2, 15, 19, *119*, 120 (fig.)
Eudistoma—Continued
  marianense, 5, 15, 19, *122*, 123 (fig.)
  olivaceus, 121
  pyriforme, 2, 7, 20, *110*, 111 (fig.)
  rigida, 117
  rubra, 7, 117
  rubrum, 15, 20, *117*, 118 (fig.)
  snakabri, 117, 119
  tokarae, 6, 15, 18, *118* (fig.)
  viride, 15, 19, *122*
  viridis, 3, 5, 122
Euherdmania claviformis, 60
  digitata, 4, 14, 19, *58*, 59 (fig.)
Eusynstyela, subg., 8, 18, 167, 168
exasperatus, Microcosmus, 5, 7, 8, 13, 16, 18, 19, 20, 21, 74, *207*, 209 (fig.), 210 (fig.), 212 (fig.), 214 (fig.), 215 (fig.), 219
fasciata, Clavelina, 104, 106
fecunda, Clavelina, 5, 15, 19, *101*, 102, 103 (fig.), 106
  Podoclavella, 101
fertilis, Cnemidocarpa, 9, 16, 17, *183* (fig.)
  Styela, 183
festum, Polyclinum, 53
formosana, Ecteinascidia, 136
  Perophora, 4, 13, 15, 19, 20, *136*
fragile, Amaroucium, 29, 30, 58
  Diplosomoides, 94
  Lissoclinum, 4, 6, 14, 18, 19, *94*, 95, 96 (fig.)
fuscum, Didemnum (Didemnum), 74
  Didemnum (Leptoclinum), 70
  Hypurgon, 74
fusiformis, Oikopleura (Coecaria), 10, 16 *228*
gegenbauri, Dolioletta, 10, 11, 12, 17, *229*
gemmata, Ascidia, 5, 13, 15, 19, 20, *140*, 141 (fig.)
gigantea, Clavelina (Synclavella), 12, 15, 21, *108*, 109 (fig.)
giganteus, Polycitor, 108, 133
gigas, Culeolus, 221
glabrum, Amaroucium, 9, 10, 11, 14, 17, *30*, 31 (fig.), 43, 44 (fig.), 45
  Amouroucium, 30
Globigerina, 10, 193, 220
globuliferum, Didemnopsis, 87
gottschaldti, Didemnum (Didemnum), 97
grande, Didemnum, 65
  Leptoclinum albidum var., 65

grandis, Cynthia, 206
  Herdmania momus f., 184
  Herdmania momus var., 13, 16, 21, 65, *206*, 207 (fig.), 208
  Syndiazona, 10, 15, 17, *133*
granulatum, Didemnum (Didemnum) moseleyi f., 3, 4, 14, 19, 63 (fig.), *67*
Halimeda, 3, 4, 6, 33, 36, 74, 77, 89, 97, 187
Halocynthia aurantium, 9, 16, 18, *219*
  mirabilis, 205
  roretzi, 12, 16, 18, *219*
  sanderi, 197
Hartmeyeria *chinensis*, 8, 16, 18, *225*, 227 (fig.), 228 (fig.)
  longistigmata, 224
  orientalis, 9, 16, 18, *224*, 225 (fig.), 226, 228
hawaiiensis, Leptoclinides, 10, 14, 20, 91 (fig.), *92*
  Styela izuana, 10, 16, 20, *193*, 194 (fig.)
Helipora, 8
herdmani, Culeolus, 220
Herdmania mirabilis, 9, 16, 18, *205*
  momus, 5, 8, 9, 16, 18, 19, 72, 183, 191, *205*
  momus f. grandis, 184
  momus var. grandis, 13, 16, 21, 65, *206*, 207 (fig.), 208
hexagona, Metcalfina, 10, 11, 17, *230*
Holozoa cylindrica, 131
  cylindrica f. typica, 131
Hypodistoma, 124
  vastum, 4, 15, 19, *126*, 127 (fig.)
Hypurgon fuscum, 74
  skeati, 75
ianthinus, Polycitor, 128
Iasis zonaria, 11, 17, *230*
imperfecta, Ecteinascidia, 4, 15, 19, *137* (fig.)
incubita, Cnemidocarpa, 5, 16, 19, *186*, 187 (fig.), 188 (fig.)
  Styela, 186, 187, 188
intermedium, Doliolina, 12, 17, *229*
interrupta, Molgula (Molgula), 224
intestinalis, Ciona, 133
inversus, Culeolus, 221
irma, Cnemidocarpa, 181
  Styela (Cnemidocarpa), 181
Isognomon, 4, 137
iwayamae, Polycarpa, 4, 7, 8, 13, 16, 20, 65, 67, *174*, 175 (fig.)
izuana, Molstyela, 193
  Styela, *193*, 194, 195
japonica, Corella, 9, 10, 15, 17, *148* (fig.)
japonicum, Aphanibranchion, 133
jolense, Didemnopsis, 82, 84, 85
  Trididemnum var. savignii, 3, 4, 6, 7, 8, 13, 14, 18, 19, 20, 21, *82*, 83 (fig.)
julinea, Phallusia, 4, 15, 19, *147* (fig.)
julinii, Microcosmus, 206
kura, Microcosmus, 207
larraburei, Dromidia, 62
laxum, Polyclinum, 51
laysani, Distoma, 119
  Eudistoma, 2, 15, 19, *119*, 120 (fig.)
  Polycitor, 119
leachi, Botrylloides, 160
lepidoderma, Pyura, 9, 16, 17, *198*, 199 (fig.)
Leptoclinides, 91
  hawaiiensis, 10, 14, 20, 91 (fig.), *92*
  reticulatus, 3, 7, 14, 19, 20, *89*, 91 (fig.)
  sparsus, 89, 92
Leptoclinum, 6, 73, 95, 100
  albidum var. grande, 65
  caliciforme, 100, 101
  macdonaldi, 100, 101
  mitsukurii, 10, 12, 15, 17, 18, *100*, 101
  moseleyi, 65
  okai, 100
  tonga, 70
  virens, 3, 5, 6, 7, 13, 15, 18, 19, 20, *98*, 99 (fig.)
  viride, 87, 89, 98
Leptoclinum, subg., 65, 70
Leptoclinum sp., 15, 18, *100*
Lissoclinum fragile, 4, 6, 14, 18, 19, *94*, 95, 96 (fig.)
  molle, 5, 14, 19, *95*, 96 (fig.)
  patella, 4, 6, 14, 18, 19, *96*, 98
  pulvinum, 3, 5, 6, 7, 8, 15, 18, 19, 20, 77, 78, 96 (fig.), *97*
lobatum, Aplidium, 3, 5, 6, 7, 14, 18, 19, 20, *22*, 23 (fig.), 24
  Aplidium sp. aff., 14, 18, 23 (fig.), *24*
longa, Ciallusia, 11, 15, 18, *133*, 135 (fig.)
longicauda, Oikopleura (Coecaria), 10, 16, *228*
longistigmata, Hartmeyeria, 224
longistriata, Ascidia, 146, 147
lutea, Cynthia, 204

macdonaldi, Leptoclinum, 100, 101
macrogastra, Cnemidocarpa, 9, 16, 17, *183* (fig.), 186
  Styela, 183
macrophyllum, Polyclinum, 53
macrospiculatum, Didemnum (Didemnum), 7, 14, 20, *71* (fig.)
magnicoecum, Botrylloides nigrum var., 153
magnicoecus, Botryllus, 8, 16, 18, *153*, 154 (fig.)
marginatus, Botrylloides violaceus, 3, 5, 16, 20, *160*, 161 (fig.)
marianense, Eudistoma, 5, 15, 19, *122*, 123 (fig.)
Marmollaria sp., 165
masuii, Pyura, 197
melanosiphonica, Polycarpa, 5, 8, 16, 19, 20, *178*, 179 (fig.)
meridionalis, Clavelina (Podoclavella), 104
  Podoclavella, 104
Metalfina hexagona, 10, 11, 17, *230*
Microcosmus claudicans var. australis, 207
  curvus, 4, 5, 13, 16, 19, 20, *215*, 217 (fig.), 218 (fig.)
  draschii, 206
  exasperatus, 5, 7, 8, 13, 16, 18, 19, 20, 21, 74, *207*, 209 (fig.), 210 (fig.), 212 (fig.), 214 (fig.), 215 (fig.), 219
  julinii, 206
  kura, 207
mikropnoa, Distaplia, 4, 15, 19, *129*, 130 (fig.)
mikropnous, Polyclinum, 129
minuta, Ascidia, 3, 15, 19, *142* (fig.)
mirabilis, Cynthia, 205
  Halocynthia, 205
  Herdmania, 9, 16, 18, *205*
  Pterygascidia, 136
  Pyura, 184, 205
misakiense, Didemnum (Didemnum), 10, 11, 14, 17, 18, *75*, 76 (fig.), 81
  Sarcodidemnoides, 75
mitsukurii, Diplosoma, 100
  Leptoclinum, 10, 12, 15, 17, 18, *100*, 101
Molgula (Molgula) exenophora, 8, 16, 18, 177, *222*, 223 (fig.)
  (Molgula) interrupta, 224
Molgula, subg., 8, 16, 18, 177, 222, 223, 224
Molgulidae, 16 (list), 222
molguloides, Cnemidocarpa fertilis, 191
molle, Diplosomoides, 95
  Lissoclinum, 5, 14, 19, *95*, 96 (fig.)
molluccensis, Clavelina, 4, 5, 15, 19, 102, *104*, 105 (fig.), 108
  Podoclavella, 104
Molstyela izuana, 193
momus, Herdmania, 5, 8, 9, 16, 18, 19, 72, 183, 191, *205*
monotestis, Polyandrocarpa (Eusynstyela), 8, 16, 18, *167*, 168 (fig.)
monotonicum, Amaroucium, 33, 35
  Amaroucium sp. aff., 5, 14, 19, *33*, 34 (fig.)
moseleyi, Culeolus, 221
  Didemnum, 90
  Didemnum (Didemnum), 3, 4, 5, 6, 7, 10, 11, 13, 14, 17, 18, 19, 20, 21, 63 (fig.), *65*, 66, 69, 70, 74
  Leptoclinum, 65
multiplicatum, Amaroucium, 5, 8, 14, 19, 20, *35*, 36, 37 (fig.), 38 (fig.), 39, 40, 43
  Amaroucium sp. aff., 35, 39
  Aplidium, 35
murrayi, Culeolus, 221
Musculus sp., 206
nationalis, Doliolum, 12, 17, *229*
nekozita, Didemnum (Didemnum), 3, 5, 6, 14, 18, 19, *67*, 68 (fig.), 70
neptunium, Polyclinum, 53
oblonga, Clavelina, 108
oceania, Symplegma, 165
Oikopleura (Coecaria) fusiformis, 10, 16, *228*
  (Coecaria) longicuada, 10, 16, *228*
Oikopleuridae, 16 (list), 228
okai, Leptoclinum, 100
olivaceus, Eudistoma, 121
orientalis, Hartmeyeria, 9, 16, 18, *224*, 225 (fig.), 226, 228
  Perophora, 136
  Thalia democratica var., 11, 17, *230*
pachydermatina, Boltenia 204
  Pyura, 13, 16, 21, *204* (fig.)
Padina, 4
Pandocia aurata, 169
  quadrata, 170
papillosa, Ascidia, 9, 15, 17, *145*, 146 (fig.)
patella, Didemnoides, 96
  Didemnum (Didemnum), 96
  Lissoclinum, 4, 6, 14, 18, 19, *96*, 98

pedunculata, Polycarpa, 169
Perophora, 6
  bermudensis, 136
  formosana, 4, 13, 15, 19, 20, *136*
  orientalis, 136
Perophora sp., 15, 18, *137*
Perophoridae, 15 (list), 136
personata, Cnemidocarpa, 13, 16, 21, *184*, 185 (fig.)
  Styela, 184
Phallusia julinea, 4, 15, 19, *147* (fig.)
philippinense, Echinoclinum, 6, 14, 18, *93* (fig.)
Phlebobranchia, 15 (list), 133
plana, Polycarpa aurata var., 169
planum, Trididemnum, 85, 87
plata, Styela, 195
plicata, Ascidia, 190
  Styela, 12, 16, 18, *190*
pliciferum, Amaroucium, 10, 14, 20, *32*, 33 (fig.)
pneumonodes, Styela (Polycarpa), 169
Pocillopora, 140
Podoclavella, fecunda, 101
  meridionalis, 104
  molluccensis, 104
Podoclavella, subg., 104
Polyandrocarpa (Eusynstyela) sp. aff. monotestis, 8, 16, 18, *167*, 168 (fig.)
Polycarpa aurata, 12, 16, 20, *169* (fig.)
  aurata var. plana, 169
  captiosa, 4, 5, 16, 19, 20, *171*, 172 (fig.), 181
  cryptocarpa, 4, 5, 7, 8, 13, 16, 20, 62, 63, 64, 72, 122, *173*, 174 (fig.), 176
  iwayamae, 4, 7, 8, 13, 16, 20, 65, 67, *174*, 175 (fig.)
  melanosiphonica, 5, 8, 16, 19, 20, *178*, 179 (fig.)
  pedunculata, 169
  psammotesta, 9, 16, 17, *176*, 177 (fig.)
  quadrata, 4, 16, 20, *170*, 171 (fig.)
  sulcata, 169
Polycarpa, subg., 169
Polycarpa sp. 3, 16, 20, *180* (fig.)
Polycitor amplus, 112, 121
  coalitus, 128
  giganteus, 108, 133
  ianthinus, 128
  laysani, 119
  paesslerioides var. angolanus, 112
  torosus, 128
Polycitoridae, 15 (list), 101
Polyclinid in strobilization, 14, 17, *60*, 61 (fig.)
Polyclinum, 47, 52
  constellatum, 3, 8, 10, 14, 17, 19, 20, *53*, 54 (fig.)
  festum, 53
  laxum, 51
  macrophyllum, 53
  mikropnous, 129
  neptunium, 53
  tsutsuii, 5, 6, 8, 14, 18, 19, 20, *47*, 48 (fig.), 51, 53
  vasculosum, 5, 6, 13, 14, 18, 19, 20, 50 (fig.), *51*, 53, 56
Polycyclus rufus, 153
Polysyncraton, subg., 3, 7, 19, 20, 78
Porites lobata, 7
primigenus, Botryllus, 5, 8, 15, 18, 19, *151*
psammaplidium pyriforme, 110
psammotesta, Polycarpa, 9, 16, 17, *176*, 177 (fig.)
psoloessa, Styela, 169
Pterygascidia, 136
  mirabilis, 136
pulvinum, Didemnum (Didemnum), 97
  Lissoclinum, 3, 5, 6, 7, 8, 15, 18, 19, 20, 77, 78, 96 (fig.), *97*
purpureum, Botrylloides, 156
pyramidalis, Culeolus, 222
pyriforme, Eudistoma, 2, 7, 20, *110*, 111 (fig.)
  Psammaplidium, 110
Pyrosoma agassizi, 9, 17, *230*, 231 (fig.)
Pyrosomata, 17 (list), 230
Pyrosomidae, 17 (list), 230
Pyura aspera, 197
  curvigona, 4, 16, 20, *199*, 200 (fig.), 201 (fig.)
  lepidoderma, 9, 16, 17, *198*, 199 (fig.)
  masuii, 197
  mirabilis, 184, 205
  pachydermatina, 13, 16, 21, *204* (fig.)
  sacciformis, 9, 10, 16, 17, *197* (fig.)
  sanderi, 197
  vittata, 4, 16, 20, *202*, 203 (fig.)
Pyuridae, 16 (list), 197
quadrata, Culeolus, 220
  Pandocia, 170
  Polycarpa, 4, 16, 20, *170*, 171 (fig.)
  Styela, 170

racemosum, Sarcobotrylloides, 153
recurvatum, Didemnum, 62
reptans, Symplegma, 165
reticulatum, Didemnum, 89, 92
reticulatus, Leptoclinides, 3, 7, 14, 19, 20, *89*, 91 (fig.)
Rhodosomatidae, 15 (list), 148
rigida, Eudistoma, 117
Ritterella aff. aequalisiphonis, 9, 14, 17, 56, 57 (fig).
Ritterella (=Sigillinaria), 58
roretzi, Halocynthia, 12, 16, 18, *219*
Roretzi, (?Styela) Cynthia, 219
rubra, Eudistoma, 7, 117
rubrum, Eudistoma, 15, 20, *117*, 118 (fig.)
rufus, Botryllus, 153, 155
  Polycyclus, 153
sacciformis, Cynthia, 197
  Pyura, 9, 10, 16, 17, *197* (fig.)
sagamiana, Didemnum (Polysyncraton), 3, 14, 19, *78*, 79 (fig.)
sagamiense, Amaroucium, 36, 40, 43
Salpa cylindrica, 11, 17, *230*
  maxima var. tuberculata, 11, 17, *229*, 231 (fig.)
Salpidae, 17 (list), 229
samea, Ascidia, 138
  Ascidia sydneiensis, 11, 15, 18, *138*, 139 (fig.)
sanderi, Cynthia, 197
  Halocynthia, 197
  Pyura, 197
Sarcobotrylloides racemosum, 153
Sarcodidemnoides misakiense, 75
Sargassum, 3
savignii, Didemnum, 80
  Trididemnum, 3, 5, 10, 11, 14, 17, 18, 19, 21, *80*, 81 (fig.), 82, 85
semifuscum, Didemnum (Polysyncraton), 7, 14, 20, *78*, 79 (fig.)
Seriatopora, 4, 99
Sertularia sp., 205
siboja, Chelyosoma, 9, 15, 17, *150* (fig.)
Sigillina vasta, 126
Sigillinaria aequali-siphonis, 56
(Sigillinaria), Ritterella, 58
siphonale, Didemnum (Didemnum), 9, 14, 17, *72*, 73 (fig.)
skeati, Hypurgon, 75
sluiteri, Culeolus, 222
snakabri, Eudistoma, 117, 119
solidum, Amaroucium, 56
sparsus, Leptoclinides, 89, 92
sphaericum, Didemnum (Didemnum), 5, 14, 19, *70*, 71 (fig.)
spitzbergense, Amaroucium, 26
  Aplidium, 9, 14, 17, *26*, 27 (fig.)
sponges, 3, 4
spongiodes, Didemnum (Leptoclinum), 70
Stereoclavella australis, 106
Stereoclavella sp., 106
Stolidobranchia, 15 (list), 151
Stolonica styeliformis, 11, 16, 18, 80, *165*, 166 (fig.)
Styela areolata, 181
  atlantica, 9, 16, 17, *191*, 192 (fig.)
  (Botryorchis) atlantica, 191
  captiosa, 171
  clava, 9, 11, 12, 16, 17, 18, *190* (fig.)
  coriacea, 9, 16, 17, *195*, 196 (fig.)
  cryptocarpa, 173
  etheridgii, 184
  fertilis, 183
  incubita, 186, 187, 188
  (Cnemidocarpa) irma, 181
  izuana, *193*, 194, 195
  izuana *hawaiiensis*, 10, 16, 20, *193*, 194 (fig.)
  macrogastra, 183
  personata, 184
  plata, 195
  plicata, 12, 16, 18, *190*
  (Polycarpa) pneumonodes, 169
  psoloessa, 169
  quadrata, 170
(?Styela) Cynthia Roretzi, 219
Styelidae, 15 (list), 162
styeliformis, Stolonica, 11, 16, 18, 80, *165*, 166 (fig.)
suhmi, Culeolus, 222
sulcata, Polycarpa, 169
sulcatum, Didemnoides, 96, 97
Sycozoa, 129
Symplegma connectens, 165
  oceania, 165
  reptans, 165
  viride, 3, 8, 12, 16, 18, 20, *162*, 163 (fig.), 164
  viride brakenhielmi, 162
  viride f. brakenhielmi, 162
Synclavella, 69, 108
Synclavella, subg., 4, 5, 12, 15, 19, 21, 106, 108
Synclavella sp., 69
Syndiazona, 133
  grandis, 10, 15, 17, *133*

Synoicidae, 10, 14 (list), 22
Telesto, 151
ternatanum, Didemnoides, 77
Didemnum, 65, 78
Didemnum (Didemnum), 2, 3, 5, 6, 14, 18, 19, 33, 76 (fig.), *77*, 97
Tethyum atlanticum, 191
Thalia democratica var. orientalis, 11, 17, *230*
Thaliacea, 17 (list), 228
thysanotus, Culeolus, 221
tokarae, Eudistoma, 6, 15, 18, *118* (fig.)
tokaraensis, Aplidiopsis, 47
tonga, Leptoclinum, 70
torosus, Polycitor, 128
tremulum, Aplidium, 22, 24
Trididemnum, 81, 87
cyclops, 7, 8, 14, 20, *85*, 86 (fig.)
planum, 85, 87
savignii, 3, 5, 10, 11, 14, 17, 18, 19, 21, *80*, 81 (fig.), 82, 85
savignii var. jolense, 3, 4, 6, 7, 8, 13, 14, 18, 19, 20, 21, *82*, 83 (fig.)
viride, 6, 14, 18, *87*, 88 (fig.)
tritonis, Dolioletta gegenbauri, 9, 12, 17, *229*
tsutsuii, Polyclinum, 5, 6, 8, 14, 18, 19, 20, *47*, 48 (fig.), 51, 53
tuberatus Botryllus, 3, 7, 8, 15, 18, 20, *151*, 152 (fig.)
tuberculata, Salpa maxima var., 11, 17, *229*, 231 (fig.)
Turbinaria, 3, 65, 160
typica, Distaplia cylindrica f., 13, 15, 21, *131*, 132 (fig.)
Holozoa cylindrica f., 131
tyreum, Botrylloides, 3, 16, 20, *156*, 157 (fig.)
undentata, Dromidia, 126
valborg, Cnemidocarpa, 181
Valonia, 65, 97
variable, Amaroucium, 45, 47
vasculosum, Polyclinum, 5, 6, 13, 14, 18, 19, 20, 50 (fig.), *51*, 53, 56
vasta, Sigillina, 126
vastum, Hypodistoma, 4, 15, 19, *126*, 127 (fig.)
verrilli, Echinoclinum, 94
violaceum, Botrylloides, 158
violaceus, Botrylloides, 3, 8, 16, 17, 20, *158*, 159 (fig.)
virens, Diplosoma, 98
Leptoclinum, 3, 5, 6, 7, 13, 15, 18, 19, 20, *98*, 99 (fig.)
viride, Diplosoma, 98
Eudistoma, 15, 19, *122*
Leptoclinum, 87, 89, 98
Symplegma, 3, 8, 12, 16, 18, 20, *162*, 163 (fig.), 164
Trididemnum, 6, 14, 18, *87*, 88 (fig.)
viridis, Botryllocarpa, 164
Eudistoma, 3, 5, 122
vittata, Cynthia, 202
Pyura, 4, 16, 20, *202*, 203 (fig.)
wyville-thomsoni, Culeolus, 222
xenophora, Molgula (Molgula), 8, 16, 18, 177, *222*, 223 (fig.)
yezoense, Aplidium, 8, 14, 17, *28*, 29 (fig.)
zonaria, Iasis, 11, 17, *230*

SMITHSONIAN INSTITUTION LIBRARIES
3 9088 01421 3425